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NEW CHAPTERS IN THE WARFARE OF SCIENCE.

VII. COMPARATIVE MYTHOLOGY.

By ANDREW DICKSON WHITE, LL. D., L. H. D.,
EX-PRESIDENT OF CORNELL UNIVERSITY.

PART II.

THE first effect of the Protestant Reformation was to popularize the older Dead Sea legends, and to make the public mind still more receptive for the newer ones.

Luther's great pictorial Bible, so powerful in fixing the ideas of the German people, showed by very striking engravings all three of these earlier myths—the destruction of the cities by fire from heaven, the transformation of Lot's wife, and the vile origin of the hated Moabites and Ammonites; and we find the salt statue, especially, in this and other pictorial Bibles, during generation after generation.

Catholic peoples also held their own in this display of faith. About 1517 François Regnault published at Paris a compilation on Palestine enriched with woodcuts; in this the old Dead Sea legend of the "Serpent Tyrus" reappears embellished, and with it various other new versions of old stories. Five years later Bartholomew de Salignac travels in the Holy Land, vouches for the continued existence of the Lot's wife statue, and gives new life to an old marvel by insisting that the sacred waters of the Jordan are not really poured into the infernal basin of the Dead Sea, but that they are miraculously absorbed by the earth.

These ideas were not confined to the people at large; we trace them among scholars.

In 1581 Bünting, a North German professor and theologian, published his "Itinerary of Holy Scripture," and in this the Dead Sea and Lot legends continue to increase. He tells us that the water of the sea "changes three times every day"; that it "spits forth fire"; that it throws up "on high" great foul masses which "burn like pitch" and "swim about like huge oxen"; that the statue of Lot's wife is still there, and that it shines like salt.

In 1590 Christian Adrichom, a Dutch theologian, published his famous work on sacred geography. He does not insist upon the Dead Sea legends generally, but declares that the statue of Lot's wife is still in existence, and on his map he gives a picture of her standing at Usdum.

Nor was it altogether safe to dissent from such beliefs. Just as, under the papal sway, men of science had been severely punished for wrong views of the physical geography of the earth in general, so, when Calvin decided to burn Servetus, he included in his indictment for heresy a charge that Servetus, in his edition of "Ptolemy," had made unorthodox statements regarding the physical geography of Palestine.*

So, too, Protestants and Catholics vied with each other in the making of new myths. Thus, in his "Most Devout Journey," published in 1608, Jean Zvallart, Mayor of Ath in Hainault, confesses himself troubled by conflicting stories about the salt statue, but declares himself sound in the faith that "some vestige of it still remains," and makes up for his bit of freethinking by adding a new mythical horror to the region—"crocodiles," which, with the serpents and the "foul odor of the sea," prevented his visit to the salt mountains.

In 1615 Father Jean Boucher publishes the first of many editions of his "Sacred Bouquet of the Holy Land." He depicts the horrors of the Dead Sea in a number of striking antitheses, and among these is the statement that it is made of mud rather than of water, that it soils whatever is put into it, and so corrupts the land about it that not a blade of grass grows in all that region.

In the same spirit thirteen years later, the Protestant Christopher Heidmann publishes his "Palæstina," in which he speaks of

* For biblical engravings of Lot's wife transformed into a salt statue, etc., see Luther's Bible, 1534, p. xi; also the pictorial "Electoral Bible"; also Merian's "Icones Biblicæ" of 1625; also the frontispiece of the Luther Bible published at Nuremberg in 1708; also Scheuchzer's "Kupfer Bibel," Augsburg, 1731, Tab. lxxx. For the account of the Dead Sea serpent "Tyrus," etc., see "Le Grand Voyage de Hierusalem," Paris (1517 ?), p. xxi. For De Salignac's assertion regarding the salt pillar and suggestion regarding the absorption of the Jordan before reaching the Dead Sea, see his "Itinerarium Sacræ Scripturæ," Magdeburg, 1593, §§ 34 and 35. For Bünting, see his "Itinerarium Sacræ Scripturæ," Magdeburg, 1589, pp. 78, 79. For Adrichom's picture of the salt statue, see map, p. 38, and text, p. 205, of his "Theatrum Terræ Sanctæ," 1613. For Calvin and Servetus, see Willis, "Servetus and Calvin," pp. 96 and 307; also the Servetus edition of Ptolemy.

a fluid resembling blood oozing from the rocks about the Dead Sea, and cites authorities to prove that the statue of Lot's wife still exists and gives signs of life.

Yet, as we near the end of the sixteenth century, some evidences of a healthful and fruitful skepticism begin to appear.

The old stream of travelers, commentators, and preachers, accepting tradition and repeating what they have been told, flows on; but here and there we are refreshed by the sight of a man who really begins to think and look for himself.

First among these is the French naturalist Pierre Bélon. As regards the ordinary wonders, he has the simple faith of his time. Among a multitude of similar things, he believed that he saw the stones on which the disciples were sleeping during the prayer of Christ, the stone on which the Lord sat when he raised Lazarus from the dead, the Lord's footprints on the stone from which he ascended into heaven, and, most curious of all, "the stone which the builders rejected." Yet he makes some advance on his predecessors, since he shows in one passage that he had thought out the process by which the simpler myths of Palestine were made. For, between Bethlehem and Jerusalem, he sees a field covered with small pebbles, and of these he says: "The common people tell you that a man was once sowing peas there, when Our Lady passed that way and asked him what he was doing; the man answered, 'I am sowing pebbles,' and straightway all the peas were changed into these little stones."

His ascribing belief in this explanatory transformation-myth to the "common people" marks the faint dawn of a new epoch.

Typical also of this new class is the German botanist Leonhard Rauwolf. He travels through Palestine in 1575, and, though devout and at times credulous, notes comparatively few of the old wonders, while he makes thoughtful and careful mention of things in nature that he really saw; he declines to use the eyes of the monks, and steadily uses his own to good purpose.

As we go on in the seventeenth century, this current of new thought is yet more evident; a habit of observing more carefully and of comparing observations had set in; the great voyages of discovery by Columbus, Vasco Da Gama, Magellan, and others were producing their effect, and this effect was increased by the inductive philosophy of Bacon, the reasonings of Descartes, and the suggestions of Montaigne.

So evident was this current that, as far back as the early days of the century, a great theologian, Quaresmio, of Lodi, had made up his mind to stop it forever. In 1616, therefore, he began his ponderous work entitled "The Historical, Theological, and Moral Explanation of the Holy Land." He labored upon it for nine years, gave nine years more to perfecting it, and then put it

into the hands of the great publishing house of Plantin at Antwerp; they were four years in printing and correcting it, and, when it at last appeared, it seemed certain to establish the theological view of the Holy Land for all time. While taking abundant care of other myths which he believed sanctified by our sacred books, Quaresmio devoted himself at great length to the Dead Sea, but above all to the salt statue, and divides his chapter on it into three parts, each headed by a question: First, "*How* was Lot's wife changed into a statue of salt?" Secondly, "*Where* was she thus transformed?" And, thirdly, "*Does that statue still exist?*" Through each of these divisions he fights to the end against all who are inclined to swerve in the slightest degree from the orthodox opinion. He utterly refuses to compromise with any modern theorists. To all such he says, "The narration of Moses is historical and is to be received in its natural sense, and no right-thinking man will deny this." To those who favored the figurative interpretation he says, "With such reasonings any passage of Scripture can be denied."

As to the spot where the miracle occurred, he discusses four places, but settles upon the point where the picture of the statue is given in Adrichom's map. As to the continued existence of the statue, he plays with the opposing view as a cat fondles a mouse, and then shows that the most revered ancient authorities, venerable men still living, and the Bedouins, all agree that it is still in being. Throughout the whole chapter his thoroughness in scriptural knowledge and his profundity in logic are only excelled by his scorn for those theologians who were willing to yield anything to rationalism.

So powerful was this argument that it seemed to carry everything before it, not merely throughout the Roman obedience, but among the most eminent theologians of Protestantism.

As regards the Roman Church, we may take as a type the missionary priest Eugène Roger, who, shortly after the appearance of Quaresmio's book, published his own travels in Palestine. He was an observant man, and his work counts among those of real value; but the spirit of Quaresmio had taken possession of him fully. His work is prefaced with a map showing the points of most importance in scriptural history, and among these he identifies the place where Samson slew the thousand Philistines with the jaw-bone of an ass, and where he hid the gates of Gaza; the cavern which Adam and Eve inhabited after their expulsion from paradise; the spot where Balaam's ass spoke; the tree on which Absalom was hanged; the place where Jacob wrestled with the angel; the steep place where the swine possessed of devils plunged into the sea; the spot where the prophet Elijah was taken up in a chariot of fire; and, of course, the position of the salt statue

which was once Lot's wife. He not only indicates places on land, but places in the sea; thus he shows where Jonah was swallowed by the whale, and "where St. Peter caught one hundred and fifty-three fishes."

As to the Dead Sea miracles generally, he does not dwell on them at great length; he evidently felt that Quaresmio had exhausted the subject, but he shows largely the fruits of Quaresmio's teaching in other matters. He sees, describes, and reasons with great theological acuteness upon the basilisk. The animal is about a foot and a half long, shaped like a crocodile, and kills people with its glance. The one which he saw was dead, fortunately for him, for in the time of Pope Leo IV, as he tells us, one appeared at Rome and killed many people by merely looking at them, but the Pope destroyed it with his prayers and the sign of the cross. He says that Providence has wisely and mercifully protected man by requiring the monster to cry aloud two or three times whenever he leaves his cavern, and the divine wisdom has also made it necessary that the monster should look his victim in the eye, and at a certain distance, in order that his glance may penetrate the victim's eye, and so pass at once to his heart. He also gives reason for supposing that the same divine mercy has provided that the crowing of a cock will kill a basilisk.

But even in this good and credulous missionary we see the influence of Bacon and the dawn of experimental science; for, having been told many stories regarding the salamander, he secured one, placed it alive upon the coals, and reports to us that the legends regarding its power to live in the fire are untrue. He also tried experiments with the chameleon, and found that the stories told regarding it were to be received with much allowance; but, while he uses his mind in these things after the modern method, he locks up his judgment when he discusses the letter of Scripture. A curious example of this we find in his reference to the famous text, in the thirty-eighth chapter of Ezekiel, which led the mediæval map-makers to place Jerusalem at the center of the earth. Coupling with this a text from Isaiah, he, by a theological argument, satisfies himself that the exact center of the earth is a certain spot marked on the pavement of the Church of the Holy Sepulchre: by a similar process of theological reasoning he also proves that the place where the Holy Cross stood was the identical spot first occupied by the tree which bore the forbidden fruit in the Garden of Eden.

So, too, we find the thoughts and words of Quaresmio echoing afar through the German universities, in public disquisitions, dissertations, and sermons. The great Bible commentators, both Catholic and Protestant, generally agreed in accepting them.

But, strong as this theological theory was, we find that, as

time went on, it required to be braced somewhat, and in 1692 Wedelius, Professor of Medicine at Jena, chose as the subject of his inaugural address "The Physiology of the Destruction of Sodom and of the Statue of Salt."

It is a masterly example of "sanctified science." At great length he dwells on the characteristics of sulphur, salt, and thunderbolts; mixes up scriptural texts, theology, and chemistry after a most bewildering fashion; and finally comes to the conclusion that a thunderbolt, flung by the Almighty, calcined the body of Lot's wife, and at the same time vitrified its particles into a glassy mass looking like salt.*

By such demonstrations as these of Quaresmio and Wedelius the theological view of the myth seemed fastened upon the world forever.

Not only was this view demonstrated, so far as theologico-scientific reasoning could demonstrate anything, but it was clearly shown, by a continuous chain of testimony from the earliest ages, that the salt statue at Usdum had been recognized as the body of Lot's wife by Jews, Mohammedans, and the universal Christian Church, "always, everywhere, and by all."

Under the influence of teachings like these—and of the winter rains—new wonders began to appear at the salt pillar. In 1661 the Franciscan monk Zwinner published his travels in Palestine, and gave not only all the old myths regarding the salt statue, but a new one, in some respects more striking than any of the old—for he had heard that a dog, also transformed into salt, was standing by the side of Lot's wife.

Even the more solid Benedictine scholars were carried away, and we find in the "Sacred History" by Prof. Metzger, of the Order

* For Zvallart, see his "Très dévot Voyage à Ierusalem," Antwerp, 1608, book iv, chapter viii. His journey was made twenty years before. For Father Boucher, see his "Bouquet de la Terre Saincte," Paris, 1622, pp. 447, 448. For Heidmann, see his "Palæstina," 1689, pp. 58–62. For Bélon's credulity in matters referred to, see his "Observations de Plusieurs Singularitez," etc., Paris, 1553, pp. 141–144; and for the legend of the peas changed into pebbles, p. 145; see, also, Lartet in "De Luynes," iii, p. 11. For Rauwolf, see the "Reyssebuch," and Tobler, "Bibliographia." For a good account of the influence of Montaigne in developing French skepticism, see Prévost-Paradol's study on Montaigne prefixed to the Le Clerc edition of the "Essays," Paris, 1865; also the well-known passages in Lecky's "Rationalism in Europe." For Quaresmio I have consulted both the Plantin edition of 1639 and the superb new Venice edition of 1880–'82. The latter, though less prized by book fanciers, is the more valuable, since it contains some very interesting recent notes. For the above discussion see Plantin edition, vol. ii, pp. 758 *et seq.*, and Venice edition, vol. ii, pp. 572–574. As to the effect of Quaresmio on the Protestant Church, for Wedelius, see his "De Statua Salis," Jenæ, 1692, pp. 6, 7, and elsewhere. For Eugène Roger, see his "La Terre Saincte," Paris, 1664; the map showing various sites referred to is in the preface; and for basilisks, salamanders, etc., see pp. 89–92, 139, 218, and elsewhere. For thorough discussion of the Old Testament and mediæval view of Jerusalem as the center of the earth, see Eicken, "Geschichte und System der Mittelalterlicher Weltanschauung," Stuttgart, 1887, p. 622. See, also, on next page, legend that the grave of Adam was on Mount Calvary.

of St. Benedict, published in 1700, a renewal of the declaration that the salt statue must be a "*perpetual* memorial."

But it was soon evident that the scientific current was still working beneath this ponderous mass of theological authority. A typical evidence of this we find in 1666 in the travels of Doubdan, a canon of St. Denis. As to the Dead Sea, he says that he saw no smoke, no clouds, and no "black, sticky water"; as to the statue of Lot's wife, he says, "The moderns do not believe so easily that she has lasted so long"; then, as if alarmed at his own boldness, he concedes that the sea *may* be black and sticky *in the middle;* and from Lot's wife he escapes under cover of some pious generalities. Four years later another French ecclesiastic, Jacques Goujon, referring in his published travels to the legend of the salt pillar, says: "People may believe these stories as much as they choose; I did not see it, nor did I go there." So, too, in 1697, Morison, a dignitary of the French church, having traveled in Palestine, confesses that, as to the story of the pillar of salt, he has difficulty in believing it.

The same current is observed working still more strongly in the travels of the Rev. Henry Maundrell, an English chaplain at Aleppo, who traveled through Palestine during the same year. He pours contempt over the legends of the Dead Sea in general: as to the story that birds could not fly over it, he says that he saw them flying there; as to the utter absence of life in the sea, he saw small shells in it; he sees no traces of any buried cities; and, as to the stories regarding the statue of Lot's wife and the proposal to visit it, he says, "Nor could we give faith enough to these reports to induce us to go on such an errand."

The influence of the Baconian philosophy on his mind is very clear; for, in expressing his disbelief in the Dead Sea apples, with their contents of ashes, he says that he saw none, and he cites Lord Bacon in support of skepticism on this and similar points.

But the strongest effect of this growing skepticism is seen near the end of that century, when the eminent Dutch commentator Clericus published his commentary on the Pentateuch and his "Dissertation on the Statue of Salt."

At great length he brings all his shrewdness and learning to bear against the whole legend of the actual transformation of Lot's wife and the existence of the salt pillar, and ends by saying that "the whole story is due to the vanity of some and the credulity of more."

In the beginning of the eighteenth century we find new tributaries to this rivulet of scientific thought. In 1701 Father Félix Beaugrand dismisses the Dead Sea legends and the salt statue very curtly and dryly—expressing not his belief in it, but a conventional wish to believe.

In 1709 a scholar appeared in another part of Europe and of different faith, who did far more than any of his predecessors to envelop the Dead Sea legends in an atmosphere of truth—Adrian Reland, professor at the University of Utrecht. His work on Palestine is a monument of patient scholarship, having as its nucleus a love of truth as truth: there is no irreverence in him, but he quietly brushes away a great mass of myths and legends: as to the statue of Lot's wife, he does not deign to treat it at length, but incidentally applies the comparative method to it with killing effect, for he shows that the story of its miraculous renewal is but one among many of its kind.*

Yet to superficial observers the old current of myth and marvel seemed to flow into the eighteenth century as strong as ever, and of this we may take two typical evidences. The first of these is the "Pious Pilgrimage" of Vincent Briemle. His journey was made about 1710; and his work, brought out under the auspices of a high papal functionary some years later, in a heavy quarto, gave new life to the stories of the hellish character of the Dead Sea, and especially to the miraculous renewal of the salt statue.

In 1720 came a still more striking effort to maintain the old belief on the Protestant side, for, in that year the eminent theologian Masius published his great treatise on "The Conversion of Lot's Wife into a Statue of Salt."

He evidently intended that this work should be the last word on this subject among Protestants, as Quaresmio had imagined that his work would be the last among Catholics. He develops his subject after the high scholastic and theologic manner. Calling attention first to the divine command in the New Testament, "Remember Lot's wife," he argues through a long series of chapters. In the ninth of these he discusses "the *impelling cause*" of her looking back, and introduces us to the question, formerly so often discussed by theologians, whether the soul of Lot's wife was finally saved. Here we are glad to learn that the big, warm heart of Luther lifted him above the common herd of theologians, and led him to declare that she was "a faithful and saintly woman," and that she certainly was not eternally damned. In justice to the Roman Church also it should be said that several of her most

* For Zwinner, see his "Blumenbuch des Heyligen Landes," München, 1661, p. 454. For Mezger, his "Sacra Historia," Augsburg, 1700, p. 30. For Doubdan, see his "Voyage de la Terre Sainte," Paris, 1666, pp. 338, 339; also Tobler and Gage's "Ritter." For Goujon, his "Histoire et Voiage de la Terre Saincte," Lyons, 1670, p. 230, etc. For Morison, see his "Voyage," book ii, pp. 516, 517. For Maundrell, see in Wright's "Collection," pp. 383 *et seq.* For Clericus, see his "Dissertatio de Salis Statua," in his "Pentateuch," edition of 1696, pp. 327 *et seq.* For Father Beaugrand, see his "Voyage," Paris, 1701, pp. 137 *et seq.* For Reland, see his "Palæstina," Traject. Batavorum, 1714, vol. i., pp. 61–254, and *passim.*

eminent commentators took a similar view, and insisted that the sin of Lot's wife was venial, and therefore, at the worst, could only subject her to the fires of purgatory.

The eleventh chapter discusses at length the question *how* she was converted into salt, and, mentioning many theological opinions, dwells especially upon the view of Rivetus—that a thunderbolt, made up apparently of fire, sulphur, and salt, wrought her transformation at the same time that it blasted the land; and he bases this opinion upon the twenty-ninth chapter of Deuteronomy and the one hundred and seventh Psalm.

Later, there is presented a sacred scientific theory that "saline particles entered into her until her whole body was infected"; and with this Masius connects another piece of sanctified science, to the effect that "stagnant bile" may have rendered the surface of her body "entirely shining, bitter, dry, and deformed."

Finally, in the fourth division of the second section, he comes to the great question whether the salt pillar is still in existence. On this he is full and fair. On one hand he allows that Luther thought that it was involved in the general destruction of Sodom and Gomorrah, and he cites various travelers who had failed to find it; but, on the other hand, he gives a long chain of evidence to show that it continued to exist: very wisely he reminds the reader that the positive testimony of those who have seen it must outweigh the negative testimony of those who have not, and finally decides that the salt statue is still in being.

No doubt a work like this produced a considerable effect in Protestant countries; indeed, this effect seems evident as far off as England, for, in 1720, we find in Dean Prideaux's "Old and New Testament connected" a map on which the statue of salt is carefully indicated. So, too, in Holland, in the "Sacred Geography," published at Utrecht in 1758, by the theologian Bachiène, we find him, while showing many signs of rationalism, evidently inclined to the old views as to the existence of the salt pillar; but just here comes a curious evidence of the real direction of the current of thought through the century, for, nine years later, in the German translation of Bachiène's work we find copious notes by the translator in a far more rationalistic spirit; indeed, we see the dawn of the inevitable day of compromise, for we now have, instead of the old argument that the divine power by one miraculous act changed Lot's wife into a salt pillar, the suggestion that she was caught in a shower of sulphur and saltpeter, covered by it, and that the result was a lump, which, in a general way, is called in our sacred books "a pillar of salt."*

* For Briemle, see his "Andächtige Pilgerfahrt," p. 129. For Masius, see his "De Uxore Lothi in Statuam Salis conversa," Hafniæ, 1720, especially pp. 29–31. For Dean Prideaux, see his "Old and New Testament connected in the History of the Jews," 1720,

But, from the middle of the eighteenth century, the new current sets through Palestine with ever-increasing strength. Very interesting is it to compare the great scriptural commentaries of the middle of this century with those published a century earlier.

Of the earlier ones we may take Matthew Poole's "Synopsis" as a type: as authorized by royal decree in 1667 it contains very substantial arguments for the pious belief in the statue. Of the later ones we may take the edition of the noted commentary of the Jesuit Tirinus seventy years later; while he feels bound to present the authorities, he evidently endeavors to get rid of the subject as speedily as possible under cover of conventionalities; of the spirit of Quaresmio he shows no trace.*

About 1760 came a striking evidence of the strength of this new current. The Abate Mariti then published his book upon the Holy Land; and, of this book by an Italian ecclesiastic, the most eminent of German bibliographers in this field says that it first broke a path for critical study of the Holy Land.

Mariti is entirely skeptical as to the sinking of the valley of Siddim and the overwhelming of the cities. He speaks kindly of a Capuchin Father who saw everywhere at the Dead Sea traces of the divine malediction, while he himself could not see them, and says, "It is because a Capuchin carries everywhere the five senses of faith, while I only carry those of nature." He speaks of "the lies of Josephus," and makes merry over "the rude and shapeless block" which the guide assured him was the statue of Lot's wife, explaining the want of human form in the salt pillar by telling him that this complete metamorphosis was part of her punishment.

About twenty years later another remarkable man broaches the subject in what was then known as the "philosophic" spirit —Volney. Between the years 1783 and 1785 he made an extensive journey through the Holy Land and published a volume of travels which by acuteness of thought and vigor of style secured general attention. In these, myth and legend were thrown aside, and we have an account simply dictated by the love of truth as truth. He, too, keeps the torch of science burning by applying his geological knowledge to the regions which he traverses.

As we look back over the eighteenth century we see mingled with the new current of thought, and strengthening it, a constantly increasing stream of more strictly scientific observation and reflection.

To review it briefly, in the very first years of the century Ma-

map at page 7. For Bachiène, see his "Historische und geographische Beschreibung von Palæstina," Leipzig, 1766, vol. I, pp. 118–120, and notes.

* For Poole, see "Poli Synopsis," 1669, p. 179; and for Tirinus, the Lyons' edition of his "Commentary," 1736, p. 10.

raldi showed the Paris Academy of Sciences fossil fishes found in the Lebanon region; a little later, Cornelius Bruyn, in the French edition of his Eastern travels, gave well-drawn representations of fossil fishes and shells, some of them from the region of the Dead Sea. About the middle of the century Richard Pococke, Bishop of Meath, and Korte, of Altona, made more statements of the same sort; and toward the close of the century, as we have seen, Volney gave still more of these researches, with philosophical deductions from them.

The result of all this was that there gradually dawned upon thinking men the conviction that, for ages before the appearance of man on the planet, and during all the period since his appearance, natural laws have been steadily in force, and in Palestine as elsewhere; this conviction obliged men to consider other than supernatural causes for the phenomena of the Dead Sea, and myth and marvel steadily shrank in value.

But at the very threshold of the nineteenth century Chateaubriand came into the field, and he seemed to banish the scientific spirit, though what he really did was to conceal it temporarily behind the vapors of his rhetoric. The time was propitious for him. It was the period of reaction after the French Revolution, when what was called religion was again in fashion, and when even atheists supported it as a good thing for common people; of such an epoch Chateaubriand, with his superficial information, thin sentiment, and showy verbiage, was the foreordained prophet. His enemies were wont to deny that he ever saw the Holy Land; whether he did or not, he added nothing to real knowledge, but simply threw a momentary glamour over the regions he described, and especially over the Dead Sea. The legend of Lot's wife he carefully avoided, for he knew too well the danger of ridicule in France.

As long as the Napoleonic and Bourbon reigns lasted, and indeed for some time afterward, this kind of dealing with the Holy Land was fashionable, and we have a long series of men, especially of Frenchmen, who evidently received their impulse from Chateaubriand.

About 1831 De Geramb, Abbot of La Trappe, evidently a very noble and devout spirit, sees vapor above the Dead Sea, but stretches the truth a little—speaking of it as "vapor or smoke." He could not find the salt statue, and complains of the "diversity of stories regarding it." The simple physical cause of this diversity—the washing out of different statues in different years—never occurs to him, but he comforts himself with the scriptural warrant for the metamorphosis.*

* For Mariti, see his "Voyage," etc., vol. ii, pp. 352–356. For Tobler's high opinion of him, see the "Bibliographia," pp. 132, 133. For Volney, see his "Voyage en Syrie et

But to the honor of scientific men and scientific truth it should be said that even under Napoleon and the Bourbons there were men who continued to explore, observe, and describe with the simple love of truth as truth, and in spite of the probability that their researches would be received during their lifetime with contempt and even hostility both in church and state.

The pioneer in this work of the nineteenth century was the German naturalist Ulrich Seetzen. He began his main investigation in 1806, and soon his learning, courage, and honesty threw a flood of new light into the Dead Sea questions.

In this light, myth and legend faded more rapidly than ever. Typical of his method is his examination of the Dead Sea fruit. He found, on reaching Palestine, that Josephus's story regarding it, which had been accepted for nearly two thousand years, was believed on all sides; more than this, he found that the original myth had so grown that a multitude of respectable people at Bethlehem and elsewhere assured him that not only apples, but pears, pomegranates, figs, lemons, and many other fruits which grow upon the shores of the Dead Sea, though beautiful to look upon, were filled with ashes. These good people declared to Seetzen that they had seen these fruits, and that, not long before, a basketful of them which had been sent to a merchant of Jaffa had turned to ashes.

Seetzen was evidently perplexed by this mass of testimony, and naturally anxious to examine these fruits. On arriving at the sea he began to look for them, and the guide soon showed him the "apples." These he found to be simply an *asclepia*, which had been described by Linnæus, and which is found in the East Indies, Arabia, Egypt, Jamaica, and elsewhere; the "ashes" were simply seeds. He looked next for the other fruits, and the guide soon found for him the "lemons"; these he discovered to be a species of *solanum* found in other parts of Palestine and elsewhere, and the seeds in these were the famous "cinders." He looked next for the pears, figs, and other accursed fruits; but, instead of finding them filled with ashes and cinders, he found them like the same fruits in other lands, and he tells us that he ate the figs with much pleasure.

So perished a myth which had been kept alive two thousand years, partly by modes of thought natural to theologians, partly by the self-interest of guides, and partly by the love of marvel-mongering among travelers.

Egypte," Paris, 1807, i, 308 *et seq.*; also, for a statement of contributions of the eighteenth century to geology, Lartet in De Luynes's "Mer Morte," vol. iii, p. 12. For Cornelius Bruyn, see French edition of his works, 1714, in which his name is given as "Le Brun," especially for representations of fossils, pp. 309 and 375. For Chateaubriand, see his "Voyage," etc., vol. ii, part iii. For De Geramb, see his "Voyage," ii, 45–47.

The other myths fared no better. As to the appearance of the sea, he found its waters not "black and sticky," but blue and transparent; he found no smoke rising from the abyss, but tells us that sunlight and cloud and shore were pleasantly reflected from the surface. As to Lot's wife, he found no salt pillar which had been a careless woman, but the Arabs showed him many bowlders which had once been wicked men.

His work was worthily continued by a long succession of true and reverent men, among them such travelers or geographers as Burckhardt, Irby, Mangles, Fallmerayer, and Carl von Raumer: by men like these the atmosphere of myth and legend was steadily cleared away; as a rule, they simply forgot Lot's wife altogether.

Greatest of all in this noble succession was an American theologian, Dr. Edward Robinson, professor at New York, a man of whom his country and humanity may well be proud.

Beginning about 1826, he devoted himself for thirty years to the thorough study of the geography of Palestine, and he found a worthy coadjutor in another American divine, Dr. Eli Smith. Neither of these men departed openly from the old traditions; that would have cost a heart-breaking price, the loss of all further opportunity to carry on their researches. Robinson did not even think it best to call attention to the mythical character of much on which his predecessors had insisted; he simply brought in, more and more, the dry, clear atmosphere of the love of truth for truth's sake, and, in this, myths and legends steadily disappeared.

By doing this he rendered a far greater service to real Christianity than any other theologian had ever done in this field.

Very characteristic is his dealing with the myth of Lot's wife. Though more than once at Usdum, though giving valuable information regarding the sea, shore, and mountains there, he carefully avoids all mention of the salt pillar and of the legend which arose from it. In this he set an example followed by most of the more thoughtful religious travelers since his time. Very significant is it to see the New Testament injunction, "Remember Lot's wife," so utterly forgotten. These later investigators seem never to have heard of it, and this constant forgetfulness shows the change which had taken place in the enlightened thinking of the world.

But in the year 1848 came an episode very striking in its character and effect.

At that time, the war between the United States and Mexico having closed, Lieutenant Lynch, of the United States Navy, found himself in the port of Vera Cruz, commanding an old hulk, the Supply. Looking about for something to do, it occurred to him to write to the Secretary of the Navy asking permission to

explore the Dead Sea. Under ordinary circumstances the proposal would doubtless have been strangled with red tape; but fortunately the Secretary at that time was Mr. John Y. Mason, of Virginia. Mr. Mason was famous for his good nature: both at Washington and at Paris, where he was afterward minister, this predominant trait has left a multitude of amusing traditions; it was of him that Thomas Benton said, "To be supremely happy he must have his paunch full of oysters and his hands full of cards."

The Secretary granted permission, but evidently gave the matter not another thought. As a result, came an expedition the most comical and one of the most rich in results to be found in American annals. Never was anything so happy-go-lucky. Lieutenant Lynch started with his hulk, with hardly an instrument save those ordinarily found on shipboard, and with a body of men probably the most unfit for anything like scientific investigation ever sent on such an errand; fortunately, he picked up a young instructor in mathematics, Mr. Anderson, and added to his apparatus two strong iron boats.

Arriving, after a tedious voyage, on the coast of Asia Minor, he set at work. He had no adequate preparation in general history, archæology, or the physical sciences, but he had his American patriotism, energy, pluck, pride, and devotion to duty, and these qualities stood him in good stead. With great labor he got the iron boats across the country. Then the tug of war began. First of all investigators, he forced his way through the whole length of the river Jordan and from end to end of the Dead Sea. There were constant difficulties, geographical, climatic, and personal, but Lynch cut through them all. He was brave or shrewd, as there was need. Anderson proved an admirable helper, and together they made surveys of distances, altitudes, depths, and sundry simple investigations in a geological, mineralogical, and chemical way. Much was poorly done, much was left undone, but the general result was most honorable both to Lynch and Anderson, and Secretary Mason found that his easy-going patronage of the enterprise was the best act of his official life.

The results of this expedition on public opinion were most curious. Lynch was no scholar in any sense; he had traveled little, and thought less on the real questions underlying the whole investigation; as to the difference in depth of the two parts of the lake, he jumped—with a sailor's disregard of logic—to the conclusion that it somehow proved the mythical account of the overwhelming of the cities, and he indulges in reflections of a sort probably suggested by his recollections of American Sunday schools.

Especially noteworthy is his treatment of the legend of Lot's wife. He found the pillar of salt. It happened to be at that

period a circular column of friable salt rock, about forty feet high; yet, while he accepts every other old myth, he declares the belief that this was once the wife of Lot "a superstition."

One little circumstance added enormously to the influence of this book, for, as a frontispiece, he inserted a picture of the salt column. It was delineated in rather a poetic manner; light streamed upon it, heavy clouds hung above it, and as a background were ranged buttresses of salt rock, furrowed and channeled out by the winter rains: this salt statue picture was spread far and wide, and in thousands of country pulpits and Sunday schools it was shown as a tribute of science to Scripture.

Nor was this influence confined to American Sunday-school children, for Lynch had innocently set a trap into which several European theologians stumbled. One of these was Dr. Lorenz Gratz, Vicar-General of Augsburg, a theological professor. In the second edition of his "Theatre of the Holy Scriptures," published in 1858, he hails Lynch's discovery of the salt pillar with joy; forgets his allusion to the old theory regarding it as a superstition; and does not stop to learn that this was one of a succession of statues washed out yearly by the rains, but accepts it as the original Lot's wife.

The French churchmen suffered most. About two years after Lynch, De Saulcy visits the Dead Sea to explore it thoroughly, evidently in the interest of sacred science—and of his own promotion. Of the modest thoroughness of Robinson there is no trace in his writings. He promptly discovered the overwhelmed cities, which no one before or since has ever found, poured contempt on other investigators, and threw over his whole work an air of piety. But, unfortunately, having a Frenchman's dread of ridicule, he attempted to give a rationalistic explanation of what he calls "the enormous needles of salt washed out by the winter rain," and their connection with the Lot's wife myth, and declared his firm belief that she, "being delayed by curiosity or terror, was crushed by a rock which rolled down from the mountain, and when Lot and his children turned about they saw at the place where she had been only the rock of salt which covered her body."

But this would not do at all, and an eminent ecclesiastic privately and publicly expostulated with De Saulcy—very naturally declaring that "it was not Lot who wrote the book of Genesis."

The result was that another edition of De Saulcy's work was published by a Church Book Society, with the offending passage omitted; but a passage was retained really far more suggestive of heterodoxy, and this was an Arab legend accounting for the origin of certain rocks near the Dead Sea curiously resembling salt formations; this in effect ran as follows:

"Abraham, the friend of God, having come here one day with his mule to buy salt, the salt-workers impudently told him that they had no salt to sell, whereupon the patriarch said: 'Your words are true; you have no salt to sell,' and instantly the salt of this whole region was transformed into stone, or rather into a salt which has lost its savor."

Nothing could be more sure than this story to throw light into the mental and moral process by which the salt pillar myth was originally created.

In the years 1864 and 1865 came an expedition on a much more imposing scale—that of the Duc de Luynes. His knowledge of archæology and his wealth were freely devoted to working the mine which Lynch had opened, and, taking with him an iron vessel and several *savants*, he devoted himself especially to finding the cities of the Dead Sea, and to giving less vague accounts of them than those of De Saulcy. But he was disappointed, and honest enough to confess his disappointment. So vanished one of the most cherished parts of the legend.

But worse remained behind. In the orthodox duke's company was an acute geologist, Monsieur Lartet, who in due time made an elaborate report, which let a flood of light in upon the whole region.

The Abbé Richard had been rejoicing the orthodox heart of France by exhibiting some prehistoric flint implements as the knives which Joshua had made for circumcision. By a truthful statement Monsieur Lartet set all France laughing at him, and then turned to the geology of the Dead Sea basin. While he conceded that man may have seen some volcanic crisis there toward its end, and may have preserved a vivid remembrance of the vapor then rising, his whole argument showed irresistibly that all the phenomena of the region are due to natural causes, and that so far from a sudden rising of the lake above the valley within historic times, it has been for ages steadily subsiding.

Since Balaam was called by Balak to curse his enemies, and "blessed them altogether," there has never been a more unexpected tribute to truth.

Even the salt pillar at Usdum, as depicted in Lynch's book, aided to undermine the myth among thinking men, for the background of the picture showed them other pillars of salt in process of formation; and the ultimate result of all these expeditions of the century was to spread an atmosphere in which myth and legend became more and more attenuated.

To sum up the main points in this work of the nineteenth century, Seetzen, Robinson, and others had found that a human being could traverse the lake without being killed by hellish smoke; that the water gave forth no odors: that the fruits of the region

were not created full of cinders to match the desolation of the Dead Sea, but were growths not uncommon in Asia Minor and elsewhere; in fact, that all the phenomena were due to natural causes.

Ritter and others had shown that all noted features of the Dead Sea and the surrounding country were to be found in various other lakes and regions, to which no supernatural cause was ascribed among enlightened men. Lynch, Van de Velde, Osborne, and others had revealed the fact that the "pillar of salt" was frequently formed anew by the rains; and Lartet and other geologists had given a final blow to the myths by making it clear from the markings on the neighboring rocks that, instead of a sudden upheaval of the sea above the valley of Siddim, there had been a gradual subsidence for ages.*

Even before all this evidence was in, a judicial decision had been pronounced upon the whole question by an authority both Christian and scientific, from which there could be no appeal. During the second quarter of the century Prof. Carl Ritter, of the University of Berlin, began giving to the world those researches which have placed him at the head of all geographers ancient or modern, and finally he brought together those relating to the geography of the Holy Land, publishing them as part of his great work on the physical geography of the earth. He was a Christian, and nothing could be more reverent than his treatment of the whole subject; but his German honesty did not permit him to conceal the truth, and he simply classed together all the stories of the Dead Sea—old and new—no matter where found, whether in the sacred books of Jews, Christians, or Mohammedans; whether in lives of saints or accounts of travelers, as "myths" and "sagas."

From this decision there has never been among intelligent men any appeal.

* For Seetzen, see his "Reisen," edited by Kruse, Berlin, 1854–'59; for the "Dead Sea Fruits," vol. ii, p. 231 *et seq.*; for the appearance of the sea, etc., p. 243, and elsewhere; for the Arab transformation explanatory legends, vol. iii, pp. 7, 14, 17. As to similarity of the "pillars of salt" to columns washed out by rains elsewhere, see Kruse's "Commentary" in vol. iv, p. 240; also Fallmerayer, i, 197. For Irby and Mangles, see work already cited. For Robinson, see his "Biblical Researches," London, 1841; also his "Later Biblical Researches," London, 1856. For Lynch, see his "Narrative," London, 1849. For Gratz, see his "Schauplatz der Heyl. Schrift.," pp. 186, 187. For De Saulcy, see his "Voyage autour de la Mer Morte," Paris, 1853, especially vol. i, p. 252, and his journal of early months of 1851, in vol. ii, comparing with it his work with the same title published in 1858 in the "Bibliothèque Catholique de Voyages et Romans," vol. i, pp. 78–81. For Lartet, see his papers read before Geographical Society at Paris; also citations in Robinson; but, above all, his elaborate reports which form the greater part of the second and third volumes of the monumental work which bears the name of De Luynes, already cited. For exposures of De Saulcy's credulity and errors, see Van de Velde, "Syria and Palestine," *passim*; also Canon Tristram's "Land of Israel"; also De Luynes, *passim*.

The adjustment of recent orthodox thought to this view presents some curious features. As typical we may take the travels of two German theologians between 1860 and 1870—John Kränzel, pastor in Munich; and Peter Schegg, lately professor in the university of that city.

The archdiocese of Munich-Freising is one of those in which the attempt to oppress modern scientific thought has been most steadily carried on. Its archbishops have constantly shown themselves assiduous in securing cardinals' hats by thwarting science and by stupefying education. The twin towers of the old cathedral of Munich have seemed to throw a killing shadow over intellectual development in that region. Naturally, then, these two clerical travelers from that diocese did not commit themselves to clearing away any of the Dead Sea myths; but it is significant that neither of them follows the example of so many of their clerical predecessors in defending the salt-pillar legend; they steadily avoid it altogether.

The more recent history of the salt pillar, since Lynch, deserves mention. It appears that the travelers immediately after him found it shaped by the storms into a spire; that a year or two later it had utterly disappeared; and about the year 1870 Prof. Palmer on visiting the place found at some distance from the main salt bed, as he says, "a tall, isolated needle of salt or salt rock, which does really bear a curious resemblance to an Arab woman with a child on her shoulders."

Three years later Smith's "Dictionary of the Bible" makes its concession to the old belief regarding Sodom and Gomorrah as slight as possible, and the myth of Lot's wife entirely disappears.

The theological effort to compromise with science now came in more strongly than ever. This effort had been made long before: as we have seen, it had begun to show itself decidedly as soon as the influence of the Baconian philosophy was felt. Clerc thought that the shock caused by the sight of fire from heaven killed Lot's wife instantly and made her body rigid as a statue. Eichhorn suggested that she fell into a stream of melted bitumen. Michaelis suggested that her relatives raised a monument of salt rock to her memory. Friedrichs suggested that she fell into the sea, and that the salt stiffened around her clothing, thus making a statue of her. Some claimed that a shower of sulphur came down upon her, and that the word which has been translated "salt" could possibly be translated "sulphur." Others hinted that the salt by its antiseptic qualities preserved her body as a mummy. De Saulcy, as we have seen, thought that a piece of salt rock fell upon her; and very recently Principal Dawson ventures the explanation that a flood of salt mud coming from a volcano incrusted her.

But theologians themselves were the first to show the inadequacy of these explanations. The more rationalistic pointed out the fact that they were contrary to the sacred text: Von Bohlen, an eminent professor at Königsberg, in his sturdy German honesty, declared that the salt pillar gave rise to the story, and compared the pillar of salt causing this transformation legend to the rock in Greek mythology which gave rise to the transformation legend of Niobe.

On the other hand, the more severely orthodox protested against such attempts to explain away the clear statements of Holy Writ. Dom Calmet, while presenting many of these explanations made as early as his time, gives us to understand that nearly all theologians adhered to the idea that Lot's wife was instantly and really changed into salt; and in our own time, as we shall presently see, have come some very vigorous protests.

Similar attempts were made to explain the other ancient legends regarding the Dead Sea. One of the most recent of these is that the cities of the plain, having been built with blocks of bituminous rock, were set on fire by lightning, a contemporary earthquake helping on the work. Still another is that accumulations of petroleum and inflammable gas escaped through a fissure, took fire, and so produced the catastrophe.*

Against this sort of rationalism perhaps the most vigorous of recent protests appeared in 1876, in an edition of Monseigneur Mislin's work on "The Holy Places." In order to give weight to the book, he spread his qualities at great length on the title-page. Among other things, he was prelate of the papal household, apostolic prothonotary, a doctor of theology and of philosophy, and his work is prefaced by letters from Pope Pius IX and sundry high ecclesiastics—and from Alexandre Dumas. His hatred of Protestant missionaries in the East is phenomenal; he calls them "bagmen," ascribing all mischief and infamy to them; and his hatred is only exceeded by his credulity. He cites all the arguments in favor of the salt statue at Usdum as the identical one into which Lot's wife was changed, adds some of his own, and presents her as "a type of doubt and heresy." With the proverbial facility of theologians in translating any word of a dead language into anything that suits their purpose, he says that the word in the nineteenth chapter of Genesis, which is translated "statue" or "pillar," may be translated "eternal monument"; he is especially

* For Kränzel, see his "Reise nach Jerusalem," etc.; for Schegg, his "Gedenkbuch einer Pilgerreise," etc., 1867, chapter xxiv. For Palmer, see his "Desert of the Exodus," vol. ii, pp. 478, 479. For the various compromises, see works already cited, *passim*. For Von Bohlen, see his "Genesis," Königsberg, 1835, pp. 200–213. For Calmet, see his "Dictionarium," etc., Venet., 1766. For very recent compromises, see J. W. Dawson and Dr. Cunningham Geikie in works cited.

severe on poor Monsieur De Saulcy for thinking that Lot's wife was killed by the falling of a piece of salt rock, and actually boasts that it was he who caused De Saulcy, a member of the French Institute, to suppress the obnoxious passage in a later edition.

Nor did such rationalizing efforts fare much better among Protestant theologians. In his excellent work on "The Land of Israel," Canon Tristram makes an energetic protest against scientific explanations of biblical statements.

Between 1870 and 1880 came two killing blows at the older theories, and they were dealt by two American scholars of the highest character. First of these may be mentioned Dr. Philip Schaff, a professor in the Presbyterian Theological Seminary at New York, who published his travels in 1877. In a high degree he united the scientific with the religious spirit, but the trait which made him especially fit for dealing with this subject was his straightforward German honesty. He tells the simple truth regarding the pillar of salt, so far as its physical origin and characteristics are concerned, and leaves his reader to draw the natural inference as to its relation to the myth. With the fate of Dr. Robertson Smith in Scotland and Dr. Woodrow in South Carolina before him—both recently driven from their professorships for truth-telling—Dr. Schaff deserves honor for telling as much as he does.

Similar in effect, and even more bold in statement, were the "Travels" of the Rev. Henry Osborne, published in 1878. In a truly scientific spirit he calls attention to the similarity between the Dead Sea, with the river Jordan, to sundry other lake and river systems; he points out the endless variations between writers describing the salt formations at Usdum; accounts rationally for these variations, and quotes from Dr. Anderson's report, saying, "From the soluble nature of the salt and the crumbling looseness of the marl, it might be well imagined that, while some of these needles are in process of formation, others are being washed away."

Thus came out, little by little, the truth regarding the Dead Sea myths, and especially the salt pillar at Usdum; but the final truth remained to be told, and now one of the purest men and truest divines of this century told it. Arthur Stanley, Dean of Westminster, visiting the country and thoroughly exploring it, allowed that the physical features of the Dead Sea and its shores suggested the myths and legends, and he sums up the whole as follows: "A great mass of legends and exaggerations, partly the cause and partly the result of the old belief that the cities were buried under the Dead Sea, has been gradually removed in recent years."

So, too, about the same time, Dr. Conrad Furrer, pastor of the

great church of St. Peter at Zürich, gave to the world a book of travels reverent and thoughtful, and, in this, honestly acknowledged that the needles of salt at the southern end of the Dead Sea "in primitive times gave rise to the tradition that Lot's wife was transformed into a statue of salt." Thus was the mythical character of this story at last openly confessed by leading churchmen on both continents.

Plain statements like these from such sources left the high theological position more difficult than ever, and now a new compromise was attempted. As the Siberian mother tried to save her best-beloved child from the pursuing wolves by throwing over to them her less favored children, so an effort was now made in a leading commentary to save the legends of the valley of Siddim and the miraculous destruction of the cities by throwing overboard the legend of Lot's wife.*

But even this utterly failed, for there soon followed the worst blows of all. First, from Van de Velde, who made his journey in 1851 and 1852. He is a most devout man, but he confesses that the volcanic action at the Dead Sea must have been far earlier than the catastrophe mentioned in our sacred books, and that "the overthrow of Sodom and Gomorrah had nothing to do with this." A few years later a very eminent dignitary of the English Church, Canon Tristram, doctor of divinity and fellow of the Royal Society, who had explored the Holy Land thoroughly, after some generalities about miracles, gave up the whole attempt to make science agree with the myths, and used these words: "It has been frequently assumed that the district of Usdum and its sister cities was the result of some tremendous geological catastrophe. . . . Now, careful examination by competent geologists, such as Monsieur Lartet and others, has shown that the whole district has assumed its present shape slowly and gradually through a succession of ages, and that its peculiar phenomena are similar to those of other lakes." So sank from view the whole mass of Dead Sea myths and legends, and science gained a victory both for geology and comparative mythology.

An amusing result has followed this development of opinion. As we have already seen, traveler after traveler, Catholic and Protestant, now visits the Dead Sea, and hardly one of them follows the New Testament injunction to "remember Lot's wife." Nearly every one of them seems to think it best to forget her.

* For Mislin, see his "Les Saints Lieux," Paris, 1876, vol. iii, pp. 290–293, especially note at foot of page 292. For Schaff, see his "Through Bible Lands," especially chapter xxix. See also Rev. H. S. Osborne, M. A., "Travels," etc., pp. 267 *et seq.*; also Stanley's "Sinai and Palestine," London, 1887, especially pp. 290–293. For Furrer, see his "En Palestine," Geneva, 1886, vol. i, p. 246. For the attempt to save one legend by throwing overboard the other, see Keil und Delitsch, "Biblischer Commentar ueber das Alte Testament," vol. i, pp. 155, 156. For Van de Velde, see his "Syria and Palestine," vol. ii, p. 120.

Of the great mass of pious legends they are shy enough, but that of Lot's wife, as a rule, they seem never to have heard of, and, if they do allude to it, they simply cover the whole subject with a haze of conventionality and sacred rhetoric.*

Naturally, under this state of things, there has followed the usual attempt to throw off from Christendom the responsibility of the old belief, and in 1887 came a curious effort of this sort. In that year appeared the Rev. Dr. Cunningham Geikie's valuable work on "The Holy Land and the Bible." In it he makes the following statement as to the salt formation at Usdum: "Here and there, hardened portions of salt, withstanding the water, while all around them melts and wears off, rise up isolated pillars, one of which bears among the Arabs the name of Lot's wife."

In the light of the previous history, there is something at once pathetic and comical in this attempt to throw the myth upon the shoulders of the poor Arabs. The myth was not originated by Mohammedans; it appears, as we have seen, first among the Jews, and, I need hardly remind the reader, comes out in the Book of Wisdom and in Josephus, and has been steadily maintained by fathers, martyrs, and doctors of the Church, by at least one pope, and by innumerable bishops, priests, monks, commentators, and travelers, Catholic and Protestant, ever since. In thus throwing the responsibility of the myth upon the Arabs Dr. Geikie appears to show both the "perfervid genius" of his countrymen and their incapacity to recognize a joke.

Nor is he more happy in his rationalistic explanations of the whole mass of myths. He supposes a terrific storm, in which the lightning kindled the combustible materials of the cities, aided perhaps by an earthquake; but this shows a disposition to break away from the exact statements of the sacred books which would have been most severely condemned by the universal Church during at least eighteen hundred years of its history. Nor would the explanations of Sir William Dawson have fared any better: it is very doubtful whether either of them could escape unscathed to-day from a synod of the Free Church of Scotland, or of any of the leading orthodox bodies in the Southern States of the American Union.†

* The only notice of the Lot's wife legend in the editions of Robinson at my command is a very curious one by Leopold von Buch, the eminent geologist. Robinson, with a fearlessness which does him credit, consulted Von Buch, who in his answer was evidently inclined to make things easy for Robinson by hinting that Lot was so much struck with the salt formations that he *imagined* that his wife had been changed into salt. On this theory Robinson makes no comment. See Robinson, "Biblical Researches in Palestine," etc., London, 1841, vol. ii, p. 674.

† For these most recent explanations, see Rev. Cunningham Geikie, D. D., in work cited; also Sir J. W. Dawson, "Egypt and Syria," published by the Religious Tract Society, 1887, pp. 125, 126.

How unsatisfactory all such rationalism must be to a truly theological mind is seen not only in the dealings with Prof. Robertson Smith in Scotland and Prof. Woodrow in South Carolina, but, most clearly, in a book published in 1886 by Monseigneur Hausman de Wandelbourg. This work appeared in two ponderous volumes and with a great flourish of trumpets. To the name of the author was attached a long list of titles: among other things, he is Prelate of the Pope's Household, a Mitred Abbot, Canon of the Holy Sepulchre, and a Doctor of Theology of the Pontifical University at Rome, and the work is introduced by approving letters from Pope Leo XIII and the Patriarch of Jerusalem. Monseigneur de Wandelbourg scorns the idea that the salt column at Usdum is not the statue of Lot's wife; he points out not only the danger of yielding this evidence of miracle to rationalism, but the fact that the divinely inspired authority of the Book of Wisdom, written, at the latest, two hundred and fifty years before Christ, distinctly refers to it. He summons Josephus as a witness. He dwells on the fact that Pope St. Clement, Irenæus, Hegesippus, and St. Cyril, "who as Bishop of Jerusalem must have known better than any other person what existed in Palestine," with St. Jerome, St. Chrysostom, and a multitude of others, attest as a matter of their own knowledge or of popular notoriety that the remains of Lot's wife really existed in their time in the form of a column of salt; and he points triumphantly to the fact that Lieutenant Lynch found this very column.

In the presence of such a continuous line of witnesses, some of them divinely inspired, and all of them greatly revered—a line extending through thirty-seven hundred years—he condemns most vigorously all those who do not believe that the pillar of salt now at Usdum is identical with the wife of Lot, and stigmatizes them as people who "do not wish to believe the truth of the word of God." His ignorance of many of the simplest facts bearing upon the legend is very striking, yet he does not hesitate to speak of men who know far more and have thought far more upon the subject as "grossly ignorant." The most laughable feature in his ignorance is the fact that he is utterly unaware of the annual changes in the salt statue. He is entirely ignorant of such facts as that the priest Gabriel Giraudet in the sixteenth century found the statue lying down; that the monk Zwinner found it in the seventeenth century standing, and accompanied by a dog also transformed into salt; that Prince Radziwill found no statue at all; that the pious Vincent Briemle in the eighteenth century found the monument renewing itself; that about the middle of the nineteenth century Lynch found it in the shape of a tower or column forty feet high; that within two years afterward De Saulcy found it washed into the form of a spire; that a year

later Van de Velde found it utterly washed away; and that a few years later Palmer found there "a statue bearing a striking resemblance to an Arab woman with a child in her arms." Thus ended the last great demonstration thus far on the side of sacred science—the last retreating shot from the theological rear-guard.

It is but just to say that a very great share in the honor of the victory of science in this field is due to men trained as theologians. It would naturally be so, since few others have devoted themselves to direct labor in it; yet great honor is none the less due to such men as Reland, Mariti, Robinson, Smith, Schaff, Stanley, and Tristram.

They have rendered even a greater service to religion than to science, for they have made a beginning, at least, of doing away with that enforced belief in myths as history which has become a most serious danger to Christianity.

For the worst enemy of Christianity could wish nothing more than that its main leaders should prove or insist that it can not be adopted save by those who accept, as historical, statements which enlightened men throughout the world know to be mythical. The result of such a demonstration would only be more and more to make thinking people inside the church dissemblers, and thinking people outside, scoffers.

Far better is it to welcome the aid of science, in the conviction that all truth is one, and, in the light of this truth, to allow theology and science to work together in the steady evolution of religion and morality.

The revelations made by the sciences which most directly deal with the history of man all converge in the truth that during the earlier stages of this evolution moral and spiritual teachings must be inclosed in myth, legend, and parable. "The Master" felt this when he gave to the poor peasants about him—and so to the world—his simple and beautiful illustrations. In making this truth clear, science will give to religion far more than it will take away, for it will throw new life and light into all sacred literature.

THE origin of the Malays is traced by Dr. B. Hagen to the highlands of west Sumatra, whence the peoples extended slowly eastward; the first movement being probably by the races that are now to be found only in the interior of the great islands. These "aborigines" of the islands crushed out a population already in possession, as remains of which the negritos may be taken. The Malays in the narrower sense occupying Sumatra, Malacca, and north Borneo, are to be regarded as the last emigration from this center, which occurred between the twelfth and fifteenth centuries A. D. Crosses and mixtures arose with the Indians and Chinese, who have been long in intercourse with the archipelago, and in less measure also with the Arabs. For this reason we must not expect to find the pure racial type, especially not in the coast population.

THE MISSION OF EDUCATED WOMEN.

By Mrs. M. F. ARMSTRONG.

"Love seldom haunts the breast
Where learning lies."—Pope.

"'Tis Reason's part,
To govern and to guard the heart."—Cotton.

"I loved her well; I would have loved her better
Had love been met with love;
As 'tis, I leave her
To brighter destinies, if so she deems them."—Byron.

AN article entitled "Plain Words on the Woman Question," reprinted from the "Fortnightly Review" in this magazine, is so far in the nature of an attack upon the women whom the writer calls into court as to make reply, from one or another quarter, legitimate, and indeed, I think, obligatory. As a woman, who is bound by the conditions of wife and motherhood, for which Mr. Allen makes so able a plea, I can not individually appear on either side. It is not the women whom I represent who are under discussion, but none the less are the principles involved of the deepest and most pressing interest to thoughtful women everywhere, whether they have elected the single-handed fight, or the less evident but none the less serious test which comes with motherhood and the endeavor to make a home.

My excuse, therefore, for offering myself, in a sense, as a mouthpiece for the women whom Mr. Allen classifies as "deplorable accidents" is, first, that the points raised are in reality of as much importance to married women as to their unmarried sisters; and, second, that my position gives me, I think, unusual advantages for getting at certain underlying facts.

I have been for years connected with a large educational institution, where young men and women are working, side by side, under identically similar influences. The officials and teachers in this school are largely women, and women who, to quote Mr. Allen, have become "traitors to their sex," in that they have taken upon their shoulders the burden of their own support. They are, with few exceptions, highly educated, many of them college-bred, three among them being regular physicians, while all of them, if I may be permitted to judge, are of at least average attractiveness. As to health, social position, and previous condition, they offer also, I believe, a fair average, while their intellectual standards mark them high in the scale of feminine development.

For years they have puzzled me, for they are, without doubt, representative of a social phase, and the reasons for their exist-

ence, as well as the future to which they point, offer a unique temptation to the theorist. The appearance of the article already alluded to gave me a long-desired opportunity, and I at once laid it before my friends, asking for it their serious consideration. Nowhere in America, I am sure, could the opportunity be more complete, or the response more telling; and I trust that what these women have to say for themselves will not be without interest, to those at least who have read Mr. Allen's frank and, on the whole, liberal article.

In a charming cottage, occupied by two of this misguided sisterhood, to whose *ménage* the most critical eye could find nothing lacking, there was gathered, a week or two since, an unmistakably striking assemblage of single women, well looking, well dressed, ranging from twenty to fifty years of age, every one of whom could have, in the past, married, or could still marry, were it her desire to do so.

There was not a fanatic among them; they were sensible, earnest, in some cases brilliant women, who had, with more or less intention, turned their backs upon marriage, and chosen instead lives of self-supporting independence. Why have they done this? Undoubtedly it is to more than one cause that we must look for this result; but, at the outset of the discussion, it was universally admitted that Mr. Allen is right in considering the "higher education," to which he objects, to be the most potent factor in the situation. Furthermore, the knowledge of life in all its phases, which these women have gained, both from their intellectual training and their practical experience as bread-winners for themselves and others, makes them ready to accept most of his other premises.

They admit, that is, the physical necessity for maternity, and no man can appreciate its sacredness as they do.

They admit, again, the necessity for that tremendous overloading of the sexual instinct, whose meaning Emerson interprets when he says: "The lover seeks in marriage his private felicitation and perfection, with no prospective end; and Nature hides in his happiness her own end, namely, progeny, or the perpetuity of the race."

They admit, too, the value of the institution of marriage, and, as in the case of the ideal motherhood, put its beauty and its possibilities of happiness far beyond the usual masculine conception.

As to the continuance of the race, they are far too keen to blink any facts, even when they count against themselves. The race, at all costs, must go on, and women must be wives and mothers, or, to keep exactly to the lines laid down by Mr. Allen, must at least be mothers, to the end of time. And, following

their logic to the bitter end, they admit that, under existing conditions, and probably for long periods yet to come, the women who assume motherhood as their vocation must be prepared to renounce, more or less completely, their chance for intellectual development.

To this point our argument, on the evening of which I speak, went smoothly enough. Little or no exception was taken to Mr. Allen's position. So long as he made himself only an exponent of natural laws, and of their inevitable effect upon the social fabric, there were no dissentient voices. But there came a moment when the qnestion must be put point blank, and it was then that, for the first time, we, so to speak, came down to business.

"Now," I said, from my vantage-ground of neutrality, "you have cleared the decks. No social philosopher can demand more hearty agreement with the principles of his science than you have given; no man could desire more generous acknowledgment of man's place in creation, or of the fundamental relations of the sexes, than you offer; but the main issue is still untouched. Tell me why you, as representative individuals, have not married, do not marry, and are endeavoring, so far as educational methods can do it, to perpetuate your type?"

Masculine critics will possibly here suggest that a truthful answer to the first of these questions was far and away beyond my reach; but the women to whom I was speaking were fully in earnest, and there were no evasions.

"In the first place," said a clever woman beside me, "while we deny that our education unsexes us, we are conscious that it gives us a self-control, a balance, which is of inestimable advantage to us in the practical affairs of life, and induces us to consider marriage from more than one point of view. In the past, it is the emotional nature of women which has been cultivated, often at a heavy cost. Now, her intellect is taking charge, and we believe that there is no longer any reason why, as a rule, we should be sacrificed to our own emotions. Is it not, on the whole, desirable that women should study facts and weigh reasons as men do? You may say that it is the emotional virtues which are distinctively feminine, and that, as Mr. Allen says, 'a woman's glory is to be womanly, as a man's is to be *virile*'; but can it be shown that the training of her intellect makes a woman any less capable of love and devotion? Does it make her any less willing to sacrifice herself for the good of others? I think, on the contrary, that there is abundant witness to the fact that the increase of a woman's intellectual power usually intensifies her susceptibility to high motives, from whatever source they may reach her, or through whatever channel they may come. But, certainly, she is no longer a passive recipient;

she thinks now as well as feels, and the inevitable result is that her attitude is more judicial than of old."

"Do you know," here interpolates a newly graduated collegian, "that in our colleges it has become a proverb that, if a girl isn't engaged before she is a sophomore, the chances are all against her marriage?"

The assent to this is very general, and one of the older women states the evident reasons for it: "We become more interested in our studies, more certain of our ability to take care of ourselves, and therefore less interested in men as possible lovers, and more independent of them as a means of support."

"And also," dryly remarks a very marriageable maiden, "it becomes evident to us that, as a matter of fact, the men whom our friends marry do not always come to time in their *rôle* of 'providers,' and are not infrequently ready to accept assistance at the hands of the women whom they have undertaken to support."

Apropos of this, it is here suggested that possibly the prospect of domestic drudgery is not congenial to women who have found themselves capable of different and better work; and this is assented to by several of those present who are supporting their own establishments, and paying servants to perform the household labor which would fall upon their shoulders were they in the position of the married woman of average means.

This, again, suggests a comparison as to the relative value of the normal home wherein father, mother, and children complete the group, and of those more artificial homes which lack the natural elements of union. Generous recognition is at once given of the beauty of the possible home, and of the power and importance of the woman who creates it; but that this is woman's only field is emphatically denied. There are now open to her many channels through which she can influence the race, and the question is raised as to whether the advantage in this respect is altogether on the side of the married woman. Two or three of the older women in the group, who have had long and varied experience as teachers, ask if it is not probable that among the many children who have come into their hands there are not some, at least, who owe more to their school environment than to the home life. They claim that they, as teachers, should be credited with the influence which, in the nature of things, is inseparable from the responsibility which is put upon them. "To us," they say, "and not to the already overburdened wife and mother, is given the power to lead and direct the youth of the race. Would you have us, with that in view, aim for anything less than the best? The education of English and American children is, in the main, in the hands of women, and this not because of an anomalous social condition, but because of their peculiar fitness for the work. On Mr. Allen's

own showing, these women should remain unmarried, and, if this involves a sacrifice on their part, it is left for him to show us that such sacrifice is ignoble, or in any sense threatening to the public welfare."

A response to this comes from the women physicians, who, in their work for their own sex and for children, feel, in all humility, that they are doing more for humanity than if they limited themselves to the reproduction of their kind. Granting that each of these women might leave behind her the ideal four successors, what is this in comparison with the many women whom she may have saved from disease and death; the households to which she has taught better ways; the new standards of purity and self-restraint for which she has bravely fought?

In such a discussion it is difficult not to individualize; but, well as I know these women, I am surprised at the breadth of their views, their candor, and their humility in regard to their own achievements. But it is a humility which permits no abatement of their just claims. They no longer admit any question as to their intellectual capacity. With the simplicity of conscious strength they take their place beside the men who challenge them, and are not at all afraid to face the result of their own actions. It is also plain that they are, on the whole, contented with the lot which they have chosen. The sacrifice, if it be such, has been made with open eyes and of free will, and there is no sighing after the possibilities which they have rejected.

"But," I ask, "do you never feel, especially as you grow older, the lack of some young strength upon which to lean, some fresh energy to which to bequeath your own experience?"

As might be expected, the answer to this is varied. In some instances the strength of the maternal instinct has led to the adoption of children; in others, to some special work which keeps up the connection with childhood; while again there are women, as there are men, in whom the instinct is lacking, and who find other interests sufficient to fill the gap.

Mr. Allen's suggestion as to the possible readjustment of the marriage relation, and his pledge that men will meet women halfway in any such attempt, is received without special enthusiasm. That is, the general feeling is, that it is not in the marriage relation, either in its legal or social aspect, that the root of the difficulty is to be found. Rather, they consider, it must be looked for in the standards with which men and women enter into that relation. It is constantly proved, by the evidence of happy marriages, that the contract easily adjusts itself where the parties to it comprehend and accept its terms. Not that there is not room for improvement in minor particulars, especially in the direction of certain legislative changes; but that, fundamentally, the monoga-

mous idea, the permanent union of one woman with one man, is a trustworthy basis upon which to rest the social structure.

The women of whom I am writing disclaim positively that their indifference as to marriage arises from any dissatisfaction with the institution as it now and here exists. They deny also unanimously, and backed by a good deal of proof, that their education (it being understood that they have received the modern college education, or its equivalent) in any way unfits them for the duties of wifehood and maternity, or, primarily, renders these conditions any less attractive to them than to the "domestic" type of women. On the contrary, they hold that their knowledge of physiology makes them better mothers and housekeepers; their knowledge of chemistry makes them better cooks; while, from their training in other natural sciences and in mathematics, they obtain an accuracy and fair-mindedness which is of great value to them in dealing with their children or their employés. In short, they are not afraid to match themselves in practical life with the women for whom Mr. Allen claims a development impossible to the "dulled and spiritless epicene automata" to whom his attack is addressed.

As we approach the close of the discussion, the common sense of the various speakers makes itself strongly felt. They are not theorists, but practical, healthy women, and they do not in the least deceive themselves as to the actual, every-day aspect of this question. But, on the other hand, they stand for the feminine type of which our American prophet and seer wrote thirty years ago:* "At this moment I esteem it a chief felicity of this country that it excels in women. A certain awkward consciousness of inferiority in the men may give rise to the new chivalry in behalf of 'woman's rights.' Certainly, let her be as much better placed in the laws and in social forms as the most zealous reformer can ask; but I confide so entirely in her inspiring and musical nature that I believe only herself can show us how she shall be served. The wonderful generosity of her sentiments raises her at times into heroical and godlike regions, and verifies the pictures of Minerva, Juno, or Polymnia; and, by the firmness with which she treads her upward path, she convinces the coarsest calculators that another road exists than that which their feet know." And it is therefore no surprise to find that these women of a later generation are, finally, by the loftiness of their ideas and, as it were, in spite of themselves, lifted above the plane of Mr. Allen's arguments.

They sum up the reasons why they, as individuals, do not marry, in a somewhat formidable array. "We find," they say, "that we are intellectually the equals of the men whom we meet.

* Emerson, "Essay on Manners."

It is now a fair give and take, and it is no longer required of us that we make up for the light weight of our intellects by throwing in a double measure of sentiment. Neither is it any longer necessary that we marry for the sake of a somewhat uncertain support. We are able to take care of ourselves, and we find nothing uncongenial or unsexing in our success.

"Furthermore, and above all, we see that, while the processes of evolution have pushed us so far forward that there is no longer, in our dealings with men, any serious question as to inferior or superior abilities, there still remains between our moral standards and theirs the same gap that has existed ever since the purity of woman has been tacitly recognized as essential to civilization.

"The moral sense is, in us, more highly developed than in the men who are otherwise our peers; and now that this is no longer deflected in its action by the pressure of unfair conditions, it is equivalent to a new factor in the relation of the sexes. It is evident, however, that this factor can not have full play except as the individual is independent; and it is to the single, self-supporting woman only that this independence is possible. Women who are dependent, in any direction, upon men, must, almost of necessity, condone their vices, and as a result gradually approximate to their standards, which is a consummation most devoutly *not* to be desired. We believe that there is no personal conceit in claiming that we are morally upon a higher level than men, this being a recognized fact in modern sociology; but it is a fact which repels us from the close relations of marriage, in which we now believe that we have a right to a return for all that we give. When, therefore, we find that, while we are offered intellectual companionship and provision for our physical needs, the higher demands of our spiritual nature are ignored or set aside, we naturally hesitate, and hesitating are, from Mr. Allen's point of view, lost. He looks at our problem from without, we from within. We realize, often in bitterness of heart, that our moral life, the life of our aspirations, is upon a plane which, as yet, the average man has not reached. We can never go back to him, but we stand ready to welcome him whenever he can bridge the chasm and make our standard his.

"This is our position as individuals; as a class we see no evidence that we are 'accidents,' still less that we are to be deplored. We believe indeed that, so far from this being true, we in reality represent an important phase in human development, that we are a distinct product of evolutionary forces, and that in the future it is not impossible that the 'balance of power' may be found to lie in our hands."

The value of this statement is in the fact that it comes not

from one woman but from many, and in it there is surely nothing to discourage Mr. Allen and those who think with him. The women to whom he appeals are ready to meet him, but it must be on a platform of their own choosing, and they can afford to wait. They do not ask "aid in rebelling against maternity," but they demand that the responsibilities of fatherhood shall no longer be shifted or made light of. In short, they require of the fathers of the next generation just what Mr. Allen demands for the mothers, viz., "that they shall be as strong, as wise, as pure, as sane, as healthy, as earnest, and as efficient as they can be made."

And as this demand, on the part at least of the men who make it, is presumably based not so much on any personal predilection for the qualities enumerated as upon their desire to further the best interests of the race, the argument in its favor is as valid for the one sex as for the other.

ABSOLUTE POLITICAL ETHICS.

By HERBERT SPENCER.

LIFE in Fiji at the time when Thomas Williams settled there must have been something worse than uncomfortable. One of the people who passed near the string of nine hundred stones with which Ra Undreundre recorded the number of human victims he had devoured, must have had unpleasant waking thoughts and occasionally horrible dreams. A man who had lost some fingers for breaches of ceremony, or had seen his neighbor killed by a chief for behavior not sufficiently respectful, and who remembered how King Tanoa cut off his cousin's arm, cooked it and ate it in his presence, and then had him cut to pieces, must not unfrequently have had "a bad quarter of an hour." Nor could creeping sensations have failed to run through any women who heard Tui Thakan eulogizing his dead son for cruelty, and saying that "he could kill his own wives if they offended him, and eat them afterward." Happiness could not have been general in a society where there was a liability to be one among the ten whose life-blood baptized the decks of a new canoe—a society in which the killing even of unoffending persons was no crime but a glory; and in which every one knew that his neighbor's restless ambition was to be an acknowledged murderer. Still there must have been some moderation in murdering even in Fiji. Or must we hesitate to conclude that unlimited murder would have caused extinction of the society?

The extent to which each man's possessions among the Biluchis are endangered by the predatory instincts of his neighbors, may

be judged from the fact that "a small mud tower is erected in each field, where the possessor and his retainers guard his produce." If turbulent states of society such as early histories tell of, do not show us so vividly how the habit of appropriating one another's goods interferes with social prosperity and individual comfort, yet they do not leave us in doubt respecting these results. It is an inference which few will be hardy enough to dispute, that in proportion as the time of each man, instead of being occupied in further production, is occupied in guarding that which he has produced against marauders, the total production must be diminished and the sustentation of each and all less satisfactorily achieved. And it is a manifest corollary that if each pushes beyond a certain limit the practice of trying to satisfy his needs by robbing his neighbor, the society must dissolve: solitary life will prove preferable.

A deceased friend of mine, narrating incidents in his life, told me that as a young man he sought to establish himself in Spain as a commission agent; and that, failing by expostulation or other means to obtain payment from one who had ordered goods through him, he, as a last resource, went to the man's house and presented himself before him pistol in hand—a proceeding which had the desired effect: the account was settled. Suppose now that everywhere contracts had thus to be enforced by more or less strenuous measures. Suppose that a coal-mine proprietor in Derbyshire, having sent a train-load to a London coal-merchant, had commonly to send a *posse* of colliers up to town, to stop the man's wagons and take out the horses until payment had been made. Suppose the farm laborer or the artisan was constantly in doubt whether, at the end of the week, the wages agreed upon would be forthcoming, or whether he would get only half, or whether he would have to wait six months. Suppose that daily in every shop there occurred scuffles between shopman and customer, the one to get the money without giving the goods, and the other to get the goods without paying the money. What in such case would happen to the society? What would become of its producing and distributing businesses? Is it a rash inference that industrial co-operation (of the voluntary kind at least) would cease?

"Why these absurd questions?" asks the impatient reader. "Surely every one knows that murder, assault, robbery, fraud, breach of contract, etc., are at variance with social welfare and must be punished when committed." My replies are several. In the first place, I am quite content to have the questions called absurd; because this implies a consciousness that the answers are so self-evident that it is absurd to assume the possibility of any other answers. My second reply is that I am not desirous of pressing the question *whether* we know these things, but of pressing the

question *how* we know these things. Can we know them, and do we know them, by contemplating the necessities of the case? or must we have recourse to "inductions based on careful observation and experience"? Before we make and enforce laws against murder, ought we to inquire into the social welfare and individual happiness in places where murder prevails, and observe whether or not the welfare and happiness are greater in places where murder is rare? Shall robbery be allowed to go on until, by collecting and tabulating the effects in countries where thieves predominate and in countries where thieves are but few, we are shown by induction that prosperity is greater when each man is allowed to retain that which he has earned? And is it needful to prove by accumulated evidence that breaches of contract impede production and exchange, and those benefits to each and all which mutual dependence achieves? In the third place, these instances of actions which, pushed to extremes, cause social dissolution, and which, in smaller degrees, hinder social co-operation and its benefits, I give for the purpose of asking what is their common trait. In each of such actions we see aggression—a carrying on of life in a way which directly interferes with the carrying on of another's life. The relation between effort and consequent benefit in one man, is either destroyed altogether or partially broken by the doings of another man. If it be admitted that life can be maintained only by certain activities (the internal ones being universal, and the external ones being universal for all but parasites and the immature), it must be admitted that when like-natured beings are associated, the required activities must be mutually limited; and that the highest life can result only when the associated beings are so constituted as severally to keep within the implied limits. The restrictions stated thus generally, may obviously be developed into special restrictions referring to this or that kind of conduct. These, then, I hold are *a priori* truths which admit of being known by contemplation of the conditions—axiomatic truths which bear to ethics a relation analogous to that which the mathematical axioms bear to the exact sciences.

I do not mean that these axiomatic truths are cognizable by all. For the apprehension of them, as for the apprehension of simpler axioms, a certain mental growth and a certain mental discipline are needed. In the "Treatise on Natural Philosophy" by Profs. Thomson and Tait, it is remarked that "physical axioms are axiomatic to those only who have sufficient knowledge of the action of physical causes to enable them to see at once their necessary truth." Doubtless a fact and a significant fact. A plow-boy can not form a conception of the axiom that action and reaction are equal and opposite. In the first place he lacks a sufficiently generalized idea of action—has not united into one conception

pushing and pulling, the blow of a fist, the recoil of a gun, and the attraction of a planet. Still less has he any generalized idea of reaction. And even had he these two ideas, it is probable that, defective in power of representation as he is, he would fail to recognize the necessary equality. Similarly with these *a priori* ethical truths. If a speculative member of that Fijian slave-tribe who regarded themselves as food for the chiefs had suggested that there might come a place where men would not eat one another, his implied belief that they might come to have a little respect for one another's lives, condemned as utterly without justification in experience, would be considered as fit only for a wild speculator. Facts furnished by every-day observation make it clear to the Biluchi, keeping watch in his mud tower, that possession of property can be maintained only by force; and it is most likely to him scarcely conceivable that there exist limits which, if mutually recognized, may exclude aggressions, and make it needless to mount guard over fields: only an absurd idealist (supposing such a thing known to him) would suggest the possibility. And so even of our own ancestors in feudal times, it may be concluded that, constantly going about armed and often taking refuge in strongholds, the thought of a peaceful social state would have seemed ridiculous; and the belief that there might be a recognized equality among men's claims to pursue the objects of life, and a consequent desistence from aggressions, would have been scarcely conceivable. But now that an orderly social state has been maintained for generations—now that in daily intercourse men rarely use violence, commonly pay what they owe, and in most cases respect the claims of the weak as well as those of the strong—now that they are brought up with the idea that all men are equal before the law, and daily see judicial decisions turning upon the question whether one citizen has or has not infringed upon the equal rights of another; there exist in the general mind materials for forming the conception of a *régime* in which men's activities are mutually limited, and in which maintenance of harmony depends on respect for the limits. There has arisen an ability to see that mutual limitations are necessitated when lives are carried on in proximity; and to see that there necessarily emerge definite sets of restraints applying to definite classes of actions. And it has become manifest to some, though not it seems to many, that there results an *a priori* system of absolute political ethics—a system under which men of like natures, severally so constituted as spontaneously to refrain from trespassing, may work together without friction, and with the greatest advantage to each and all.

"But men are not wholly like-natured and are unlikely to become so. Nor are they so constituted that each is solicitous for his neighbor's claims as for his own, and there is small probability

that they ever will be. Your absolute political ethics is therefore an ideal beyond the reach of the real." This is quite true. Nevertheless, much as it seems to do so, it does not in the least follow that there is no use for absolute political ethics. The contrary may clearly enough be shown. An analogy will explain the paradox.

There exists a division of physical science distinguished as abstract mechanics or absolute mechanics—absolute in the sense that its propositions are unqualified. It is concerned with statics and dynamics in their pure forms—deals with forces and motions considered as free from all interferences resulting from friction, resistances of media, and special properties of matter. If it enunciates a law of motion, it recognizes nothing which modifies manifestation of it. If it formulates the properties of the lever it treats of this assuming it to be perfectly rigid and without thickness—an impossible lever. Its theory of the screw imagines the screw to be frictionless; and in treating of the wedge, absolute incompressibility is supposed. Thus its truths are never presented in experience. Even those movements of the heavenly bodies which are deducible from its propositions are always more or less perturbed; and on the Earth the inferences to be drawn from them deviate very considerably from the results reached by experiment. Nevertheless this system of ideal mechanics is indispensable for the guidance of real mechanics. The engineer has to deal with its propositions as true in full, before he proceeds to qualify them by taking into account the natures of the materials he uses. The course which a projectile would take if subject only to the propulsive force and the attraction of the Earth must be recognized, though no such course is ever pursued: correction for atmospheric resistance can not else be made. That is to say, though, by empirical methods, applied or relative mechanics may be developed to a considerable extent, it can not be highly developed without the aid of absolute mechanics. So is it here. Relative political ethics, or that which deals with right and wrong in public affairs as partially determined by changing circumstances, can not progress without taking into account right and wrong considered apart from changing circumstances—can not do without absolute political ethics; the propositions of which, deduced from the conditions under which life is carried on in an associated state, take no account of the special circumstances of any particular associated state.

And now observe a truth which seems entirely overlooked: namely, that the set of deductions thus arrived at is verified by an immeasurably vast induction, or rather by a great assemblage of vast inductions. For what else are the laws and judicial systems of all civilized nations, and of all societies which have risen above savagery? What is the meaning of the fact that all

peoples have discovered the need for punishing murder, usually by death? How is it that where any considerable progress has been made, theft is forbidden by law, and a penalty attached to it? Why along with further advance does the enforcing of contracts become general? And what is the reason that among fully civilized peoples frauds, libels, and minor aggressions of various kinds are repressed in more or less rigorous ways? No cause can be assigned save a general uniformity in men's experiences, showing them that aggressions directly injurious to the individuals aggressed upon are indirectly injurious to society. Generation after generation observations have forced this truth on them; and generation after generation they have been developing the interdicts into greater detail. That is to say, the above fundamental principle and its corollaries arrived at *a priori* are verified in an infinity of cases *a posteriori*. Everywhere the tendency has been to carry further in practice the dictates of theory—to conform systems of law to the requirements of absolute political ethics: if not consciously, still unconsciously. Nay, indeed, is not this truth manifest in the very name used for the end aimed at—equity or equalness? Equalness of what? No answer can be given without a recognition—vague it may be, but still a recognition—of the doctrine above set forth.

Thus, instead of being described as putting faith in "long chains of deduction from abstract ethical assumptions" I ought to be described as putting faith in simple deductions from abstract ethical necessities; which deductions are verified by infinitely numerous observations and experiences of semi-civilized and civilized mankind in all ages and places. Or rather I ought to be described as one who, contemplating the restraints everywhere put upon the various kinds of transgressions, and seeing in them all a common principle everywhere dictated by the necessities of the associated state, proceeds to develop the consequences of this common principle by deduction, and to justify both the deductions and the conclusions which legislators have empirically reached by showing that the two correspond. This method of deduction verified by induction is the method of developed science at large. I do not believe that I shall be led to abandon it and change my "way of thinking" by any amount of disapproval, however strongly expressed.

Are we then to understand that by this imposing title, "Absolute Political Ethics," nothing more is meant than a theory of the needful restraints which law imposes on the actions of citizens—an ethical warrant for systems of law? Well, supposing even that I had to answer "Yes" to this question (which I do not), there would still be an ample justification for the title. Having for its subject-matter all that is comprehended under the word

"Justice," alike as formulated in law and administered by legal instrumentalities, the title has a sufficiently large area to cover. This would scarcely need saying were it not for a curious defect of thought which we are everywhere led into by habit.

Just as, when talking of knowledge, we ignore entirely that familiar knowledge of surrounding things, animate and inanimate, acquired in childhood, in the absence of which death would quickly result, and think only of that far less essential knowledge gained at school and college or from books and conversation —just as, when thinking of mathematics, we include under the name only its higher groups of truths and drop out that simpler group constituting arithmetic, though for the carrying on of life this is more important than all the rest put together; so, when politics and political ethics are discussed, there is no thought of those parts of them which include whatever is fundamental and long settled. The word political raises ideas of party-contests, ministerial changes, prospective elections, or else of the Home-Rule question, the Land-Purchase scheme, Local Option, or the Eight-Hours movement. Rarely does the word suggest law-reform, or a better judicial organization, or a purified police. And if ethics comes into consideration, it is in connection with the morals of parliamentary strife or of candidates' professions, or of electoral corruptions. Yet it needs but to look at the definition of politics ("that part of ethics which consists in the regulation and government of a nation or state, for the preservation of its safety, peace, and prosperity"), to see that the current conception fails by omitting the chief part. It needs but to consider how relatively immense a factor in the life of each man is constituted by safety of person, security of house and property, and enforcement of claims, to see that not only the largest part but the part which is vital is left out. Hence the absurdity does not exist in the conception of an absolute political ethics, but it exists in the ignoring of its subject-matter. Unless it be considered absurd to regard as absolute the interdicts against murder, burglary, fraud, and all other aggressions, it can not be considered absurd to regard as absolute the ethical system which embodies these interdicts.

It remains to add that beyond the deductions which, as we have seen, are verified by vast assemblages of inductions, there may be drawn other deductions not thus verified—deductions drawn from the same data, but which have no relevant experiences to say yes or no to them. Such deductions may be valid or invalid; and I believe that in my first work, written forty years ago and long since withdrawn from circulation, there are some invalid deductions. But to reject a principle and a method because of some invalid deductions is about as proper as it would

be to pooh-pooh arithmetic because of blunders in certain arithmetical calculations.

I turn now to a question above put—whether, by absolute political ethics, nothing more is meant than an ethical warrant for systems of law—a question to which, by implication, I answered No. And now I have to answer that it extends over a further field equally wide if less important. For beyond the relations among citizens taken individually, there are the relations between the incorporated body of citizens and each citizen. And on these relations between the State and the man, absolute political ethics gives judgments as well as on the relations between man and man. Its judgments on the relations between man and man are corollaries from its primary truth, that the activities of each in pursuing the objects of life may be rightly restricted only by the like activities of others: such others being like-natured (for the principle does not contemplate slave-societies or societies in which one race dominates over another); and its judgments on the relations between the man and the State are corollaries from the allied truth, that the activities of each citizen may be rightly limited by the incorporated body of citizens only as far as is needful for securing to him the remainder. This further limitation is a necessary accompaniment of the militant state; and must continue so long as, besides the criminalities of individual aggression, there continue the criminalities of international aggression. It is clear that the preservation of the society is an end which must take precedence of the preservation of its individuals taken singly; since the preservation of each individual and maintenance of his ability to pursue the objects of life, depend on the preservation of the society. Such restrictions upon his actions as are imposed by the necessities of war, and of preparedness for war when it is probable, are therefore ethically defensible.

And here we enter upon the many and involved questions with which relative political ethics has to deal. When originally indicating the contrast, I spoke of "absolute political ethics, or that which ought to be, as distinguished from relative political ethics, or that which is at present the nearest practicable approach to it"; and had any attention been paid to this distinction, no controversy need have arisen. Here I have to add that the qualifications which relative political ethics sets forth vary with the type of the society, which is primarily determined by the extent to which defense against other societies is needful. Where international enmity is great and the social organization has to be adapted to warlike activities, the coercion of individuals by the State is such as almost to destroy their freedom of action and

make them slaves of the State; and where this results from the necessities of defensive war (not offensive war, however), relative political ethics furnishes a warrant. Conversely, as militancy decreases, there is a diminished need both for that subordination of the individuals which is necessitated by consolidating them into a fighting machine, and for that further subordination entailed by supplying this fighting machine with the necessaries of life; and as fast as this change goes on, the warrant for State-coercion which relative political ethics furnishes becomes less and less.

Obviously it is out of the question here to enter upon the complex questions raised. It must suffice to indicate them as above. Should I be able to complete Part IV of the "Principles of Ethics" treating of "Justice," of which the first chapters only are at present written, I hope to deal adequately with these relations between the ethics of the progressive condition and the ethics of that condition which is the goal of progress—a goal ever to be recognized, though it can not be actually reached.

The grave misrepresentations dealt with in the foregoing sections, I have been able to rectify by an exposition that is mainly impersonal: allusions, only, having been made to the personal bearings of the argument. But there remain other grave misrepresentations which I can not dispose of in the same way. Life sometimes presents alternatives both of which are disagreeable, and acceptance of either of which is damaging. A choice between two such I now find myself compelled to make. Prof. Huxley, referring to me, speaks of "the gulf fixed between his way of thinking and mine": the implication being that as he regards his own "way of thinking" as the right one, my way of thinking, separated from it by a gulf, must be extremely wrong. As this tacit condemnation of my "way of thinking" touches not only the question at issue but also many other questions, and as it comes not from an anonymous critic, but from one whose statements will be taken as trustworthy, I am placed in the dilemma of either passively allowing his injurious characterization, or else of showing that it is untrue, which I can not do without describing or illustrating my "way of thinking." This is, of course, an unpleasant undertaking, and one which self-respect would ordinarily negative. But unpleasant as it is, I feel obliged to enter upon it.

Years ago Prof. Huxley criticised the political doctrine held by me, and entitled his article "Administrative Nihilism." As this doctrine includes advocacy of governmental action for the repression not only of crimes but of many minor offenses, I pointed out that if it is to be called "administrative nihilism," then still

more must the eight prohibitory clauses of the decalogue be called ethical nihilism. Prof. Huxley nevertheless thought his title a fit one; and has continued to use it in the last edition of his "Critiques and Addresses." This political doctrine held by me remains unchanged, but the view taken of it by Prof. Huxley appears to have been reversed. In an emphatic manner he has recently warned me against "undertaking to preserve the health and heal the diseases of an organism vastly more complicated than the human body," having for my guides "long chains of deduction from abstract ethical assumptions." So that while represented as one who would have no administration at all, I am represented as advocating dangerous administrative methods of healing diseases of the body politic. My policy is characterized now as a policy of no action, and now as a policy of rash action. These two characterizations are applied to the same set of beliefs, and they stand in direct contradiction. Necessarily there must be extreme error in one or both; and the latter alternative is the true one: both are wrong.

The "way of thinking" which Prof. Huxley indicates as separated by a gulf from his own, and which he implies is exclusively pursued by me, is that of reaching conclusions by "long chains of deduction from abstract ethical assumptions, hardly any link of which can be tested experimentally." On the other hand the course he advocates is that of seeking guidance from "inductions based on careful observation and experience"—a course which he implies is not pursued by me, either in the political sphere or elsewhere; certainly not in the political sphere. Now let us ask what is implied by the evidence. Up to the end of the division treating of Ecclesiastical Institutions, where it has stood still for these four years, the "Principles of Sociology" contains more than five thousand facts, gathered from accounts of more than two hundred societies, savage and civilized, ancient and modern. If, then, I am rightly described as pursuing the deductive method (exclusively, as it would appear), there arises this curious question:—How have I used for deductive purposes more facts than have been used by any other writer on Sociology for inductive purposes? "This is irrelevant," will perhaps be the rejoinder—"the question concerns not the method pursued in dealing with Sociology at large, but the method pursued in dealing with governmental actions at the present time." Merely remarking that it would be strange had I pursued one method in treating the subject at large and an opposite method in treating a small division of it, I go on to reply that I have *not* pursued the opposite method but the same method. The views I hold respecting the sphere of governmental action are everywhere supported by inductions. The essay on "Over-Legislation," dating back to 1853, is almost

wholly inductive. Inductive reasoning in support of the same views occupies the greater part of the essay on "Representative Government," much of the essay on "Parliamentary Reform: the Dangers and the Safeguards," and half of the essay on "Specialized Administration." In the "Study of Sociology," again, several masses of facts are brought in support of the same views (pp. 3, 4, 161–169, and 270–273); and once more in "The Man *versus* the State" (pp. 48–60 and 62–64) a like course is pursued. I count, in different places, eight inductive arguments, not in defense of proposals for curing the diseases of the body politic, but in reprobation of proposals for doing this. "But do not the books and essays named contain deductive arguments?" it may be asked. Certainly they do; and I should be ashamed of them if they did not. But everywhere there has been pursued what I have above said is the method of developed science—deduction verified by induction. I shall think it time to reconsider the deductions when I find the masses of facts which support them met by larger masses of facts which do the reverse. "Careful observation and experience" have not yet furnished these.

To make clear the use of an ideal for guidance in dealing with the real, I had recourse to the familiar comparison between the individual body and the body politic. I remarked that "before there can be rational treatment of a disordered state of the bodily functions, there must be a conception of what constitutes their ordered state." The guidance contemplated as derivable from such knowledge consists in exclusion of what is wrong to be done, not in directions concerning what is right to be done. This is clearly shown by the context. There is an imaginary warning against the excesses of a supposed empiric as being "at variance with physiological principles"; that is, *negatived* by them or *forbidden* by them. There is no trace whatever of any proposed treatment conforming to physiological principles, but merely an interdict against a treatment. Yet on the strength of these passages, Prof. Huxley ascribes to me the monstrous belief that the practitioner should "treat his patients by deduction from physiological principles"! Similarly with the body politic. While I have alleged that "a system of *limits and restraints* on conduct" may be deduced from the primary conditions of social co-operation, Prof. Huxley represents me as proposing to seek guidance in *healing* "the diseases of an organism vastly more complicated than the human body" by "deduction from abstract ethical assumptions!" While in both cases the guiding inferences indicated by me all come under the blank form—"Thou shalt not do this," they are represented as coming under the blank form—"Thou shalt do that." How utterly at variance is the view thus ascribed to me with the view I have myself expressed, will be seen in the following passage:

How, indeed, can any man, and how more especially can any man of scientific culture, think that special results of special political acts can be calculated, when he contemplates the incalculable complexity of the influences under which each individual, and *a fortiori* each society, develops, lives, and decays? . . .

As fast as crude conceptions of diseases and remedial measures grow up into Pathology and Therapeutics, we find increasing caution, along with increasing proof that evil is often done instead of good. This contrast is traceable not only as we pass from popular ignorance to professional knowledge, but as we pass from the smaller professional knowledge of early times to the greater professional knowledge of our own. The question with the modern physician is not as with the ancient—shall the treatment be blood-letting? shall cathartics, or shall diaphoretics be given? or shall mercurials be administered? But there rises the previous question—shall there be any treatment beyond a wholesome regimen? And even among existing physicians it happens that, in proportion as the judgment is most cultivated, there is the least yielding to the "must-do-something" impulse.

Is it not possible, then—is it not even probable, that this supposed necessity for immediate action, which is put in as an excuse for drawing quick conclusions from few data, is the concomitant of deficient knowledge? Is it not probable that as in Biology so in Sociology, the accumulation of more facts, the more critical comparison of them, and the drawing of conclusions on scientific methods, will be accompanied by increasing doubt about the benefits to be secured, and increasing fear of the mischiefs which may be worked? Is it not probable that what in the individual organism is improperly, though conveniently, called the *vis medicatrix naturæ*, may be found to have its analogue in the social organism? and will there not very likely come along with the recognition of this, the consciousness that in both cases the one thing needful is to maintain the conditions under which the natural actions have fair play?—*The Study of Sociology*, pp. 15–21.

Manifestly if, instead of saying that I proposed to treat the diseases of this complex social organism by the aid of deductions from "abstract ethical assumptions," Prof. Huxley had, contrariwise, said that I am so over-cautious that I dare not treat them at all, save by maintaining the conditions to health, he would have had ground for his statement. As early as 1853 ("Over-Legislation," pp. 62, 63) I dwelt on the involved structure of a society and the consequent difficulty and danger of dealing with it. Since then I have more than once insisted on these facts. And now that which I have been teaching for a generation is put before me as a lesson to be learned!

Replies will, I suppose, be made to some of the things said in the foregoing pages. Always there are collateral questions on which debates may be raised. I see, for instance, that one of my remarks may have given to it a meaning quite different to that which I intended. After the ascription to me of the belief that treatment of diseases should be dictated by physiological principles, rightly enough regarded by Prof. Huxley as absurd, there came from me the remark that, according to him, "the principles of physiology, as at present known, are of no use whatever for

guidance in practice"—a remark which may be interpreted as a tacit indorsement of the ascription; whereas it referred to the fact that he had recognized for the present (though not for the future) no guidance whatever beyond that of empiricism. Doubtless there may be other side-issues which I do not perceive. But no number of such can change the verdicts on the main issues. That Prof. Huxley's two characterizations of the political doctrine I hold are contradictory, is undeniable. That his description of my "way of thinking" is utterly at variance with the evidence as presented in my books, is no less demonstrated. And it is equally certain that the conceptions of right treatment, medical and political, which he ascribes to me are opposite to those I have myself set forth.—*Nineteenth Century.*

THE LAWS OF FILMS.

By SOPHIE BLEDSOE HERRICK.

THERE is scarcely anything in the world which seems more utterly outside the realm of law than a soap-bubble. The delicate film, with its exquisite floating colors, its power of instantly vanishing, leaving no trace behind, hardly seems as though it could form a link in the inexorable chain of cause and effect which we call physical law.

The atmospheric pressure on a bubble six inches in diameter is over fifteen hundred pounds, and yet the fragile film lies safely between the opposing forces of nature—the pressure of the outer air, the spring of the inclosed cushion within it, the downward pull of gravity, the upward push of the buoyant atmosphere, and the molecular forces in the film itself: so long as the bubble lasts; it is because of an exquisite adjustment of all the forces, physical and molecular, concerned in its existence.

This is, of course, the merest commonplace, and yet it is one of the commonplaces of nature, which, however well we may know them, never cease to be wonderful when they are in any degree realized. There are other laws governing films which are no less wonderful, though they are less familiarly known. A heap of bubbles blown while the pipe is dipped under the surface of soapy water looks like a chaotic huddle of bubbles of all sizes and many shapes; but, upon careful examination, it is found that never more than three films meet at an unsupported liquid edge, and never more than four edges meet at a liquid point, and that the angles are always equal; that is, films will not meet each other at an unsupported edge or point at an angle smaller than 120°—one third of a circle.

Ordinary soap-suds made with clean hot water and ivory or

pure Castile soap, and allowed to settle and clarify, or else filtered, answer very well for a series of simple and beautiful experiments in the forms assumed by soap films in order to fulfill this law of their union. There is a glyceric fluid made, which by various means has all the impurities of soap and water removed, and is toughened by the addition of pure glycerin; and this is of course better, because much more persistent. A bubble made from this glyceric fluid, and carefully protected by a tumbler or bell-glass, will last for hours, and in some cases for days.

For these experiments in form, common suds last long enough to show the forms very satisfactorily, but for experiment in color the more lasting fluid is necessary, so a recipe for it is given here.*

When frames made in various forms, by bending fine copper wire, are dipped into the fluid, it is found that the films take on the most wonderful and beautiful shapes in order to fulfill the law of their union. The material of which the films are made does not at all affect their form.

With fine, well-straightened copper wire, outline a cube; this may be done with the fingers or a pair of ordinary pliers, and the figure need not be very exact. The wires can be double along any of the lines; let one end project from some corner for a handle, to be used in dipping the frame into the fluid.

Immerse this cube in the suds, and as you lift the frame out observe the films forming and shaping themselves. They usually take for a moment the form in Fig. 1 and slowly change to Fig. 2. Sometimes they retain the first form; in this case, the central drop with a glass of low power is seen to be not really a drop of fluid, but a tiny cube of films, each meeting the film from the wire edge by a curvature of its faces at exactly the required angle, 120°. The films have constructed in their midst this tiny cube, because the twelve films could not otherwise meet in the center at the proper angle. This cube is formed and kept where a tiny bubble has been entrapped in the system of films. If no such bubble of air has been caught in with the films, they

* Plateau's mixture. This must be made in a warm room, temperature about 68° Fahr. Let one half ounce of newly made Marseilles or pure Castile soap be dissolved in one pint (twenty ounces) of hot distilled water. When the solution has cooled to about the temperature of the room, it is filtered into a bottle. In using the common filter paper (bought at a drug-store for ten cents a dozen sheets), it is better to put only a small quantity of the mixture in at a time, and to support the paper in a funnel or muslin to prevent its breaking. The paper soon clogs; it should then be renewed. The process is slow, but not troublesome. When it has all been filtered, add fifteen ounces of pure glycerin—either Price's or Scheering and Glatz's—the ordinary glycerins are not fit for the purpose. Let the mixture be violently and frequently shaken; then allow it to stand seven days; on the eighth cool it to about 37° Fahr., and filter. If the liquid comes through turbid, pour it back and filter over again through *very* porous paper.

assume the form of Fig. 2. The twelve films from the edges of the cube meet a square unsupported plate of film in the center.

With No. 2 still on the frame, dip it again into the suds. You catch a bubble by doing this which goes at once to the center (Fig. 3), and forms such a cube as existed at the center of Fig. 1,

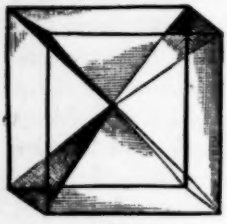

FIG. 1.

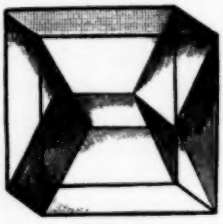

FIG. 2.

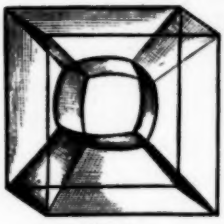

FIG. 3.

only large enough to show the curvature of the films necessary to make them meet at their fixed angle. The laws of films formulated are as follows: 1. From each wire edge of a frame proceeds a film. Generally, if care be taken, no air will be inclosed, then every film will be in contact with the surrounding air on both its faces. 2. Only three films can meet at any liquid edge. 3. When several liquid edges terminate in one point in the interior of the system, the edges are always four in number, and the angles included between them are equal. 4. Whenever the films can fulfill these conditions, and remain plain films, they are so; when they can not, they are curved, but so curved that their mean curvature is null—that is, if in one part of the film the law of its union requires an upward curvature, in some other portion there will be an equal downward curvature to compensate for it.

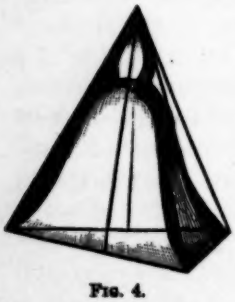

FIG. 4.

In the films upon the cube frame, for instance, there is a slight curvature, just enough to enable them to meet each other on the angle of 120°. This is a very simple digression from the plane form, but in many other frames the divergence is very marked; for instance, in the triangular pyramid (Fig. 4) with wires dividing each side, after a bubble has been entrapped by a second dip, the curvature is very remarkable.

Plateau, the blind philosopher of Ghent, first studied this subject and formulated these laws. He began his studies with some experiments far removed from our films. In order to get some idea of the interaction of the molecular forces, he removed a mass of liquid matter he was observing, as far as he could, from the action of the physical forces. Using the well-known principle that a submerged body sinks till it has displaced its own weight of the fluid in which it is immersed, he made a mixt-

ure of alcohol and water of exactly the specific gravity of oil. Into the midst of this liquid he quietly introduced oil by means of a funnel. The oil lay passive between the equal downward pull of gravity and the upward lift of the alcohol and water. In this way the forces which bound the oil particles together had free play. The oil rounded itself at once into a sphere. For a time there was, of course, some chemical action between the oil sphere and the surrounding liquid; but, in making his observations, Plateau waited till these affairs had been settled between them, and their relations became fixed.

He then introduced into his oil sphere a rod, with a disk smaller in circumference than the oil sphere about it. Both of these were well oiled, and they entered the sphere without disturbing it. The globe of oil hung in the water, with the rod running through it in the position of the earth's axis, and the disk almost reaching to the line corresponding with our equator (Fig. 5).

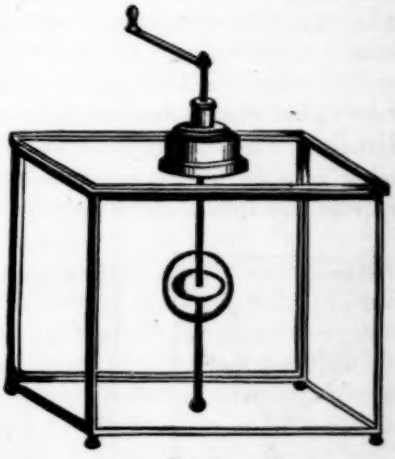

FIG. 5.

By means of a handle the rod was turned, at first slowly, then gradually and steadily faster. The oil sphere slipped more easily around in its water socket than it would around the revolving rod and disk, and therefore turned upon its own axis. By varying his experiments, revolving his rod faster or slower, Plateau made a miniature representation of a world revolving about its own axis; he made his oil sphere throw off satellites, which revolved about the central sphere; he also, by what he calls a trick, imitated Saturn with its attendant ring.

He followed these experiments by using outlined frames of wire, such as we used for our soap films. These he adjusted around his hanging sphere of oil, and with a syringe withdrew the oil, making first a cube of oil with unsupported faces; and finally, as more and more oil was withdrawn, there resulted a system of oil films, each face of which was in contact with the water, exactly like those in Figs. 1 and 2.

This was the manner in which such systems of films were first reached; and, historically, the experiments have an interest in their relation to the subject of films as well as for the proof they offer that the material of which the films are formed has nothing to do with the forms they take on. Plateau went on from his oil

films to those made with soap-suds and glyceric fluid. We have reversed the order in considering them, but it amounts to the same thing in the end.

Plateau's researches have been carried on by Brewster and others, and the subject much enriched by later experimenters. One of the most beautiful forms has not, it is believed, been published. A sphere is outlined with three equal circles, making, when joined together at equal angles, a globe with six meridians. When this is dipped in the suds, a rather complicated figure appears. It is sometimes necessary to dip this frame several times to get a perfect figure. From an axial edge of film three films start out. Just half-way between the axis and the outside curve of the sphere each of these three films meet two crescent-shaped films from two of the wire meridians, curved so that the three meet at the required angle. Sometimes when a bubble has been caught in the system, and always if a small bubble is carefully blown between two of the wires, a new figure will be formed. In an instant, as though the change were wrought by magic, the new figure flashes into existence. A long, six-sided, melon-shaped figure reaches from pole to pole inside the sphere; from each edge of this figure, entirely unsupported as it is by the wire, a crescent-shaped film reaches to each wire meridian.

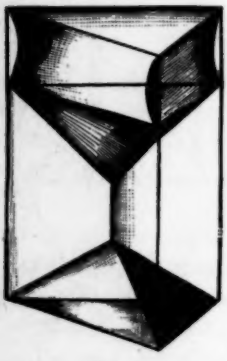

Fig. 6.

Fig. 7.

The figures formed with the wire frames are usually perfectly symmetrical; but sometimes, from the peculiar form of the frame, symmetry is not consistent with a union at the angle of 120°. The law in such a case is obeyed, and symmetry cast to the winds. In Fig. 6, at the first dip the figure is very unsymmetrical, though always the same. When a bubble is blown on the bottom, the figure starts out perfectly symmetrical in form.

Brewster has added many experiments to those of Plateau's. The next one given is his, and a very curious one it is too. Two rectangles are made of the copper wire; one is slipped within the other and held at right angles to it; they are in this position dipped into the suds. The system which starts into being can be seen in Fig. 7. The central oval stands diagonally just half-way between two of the angles made by the crossed frames. Now, if the frames are gradually turned upon each other, which it is very

easy to do, the form of the oval changes. At right angles the oval film is four times longer than it is broad. As the angle between which the oval film stands is increased, it widens till it is nearly square. If the rectangles could be made to lie exactly one upon the other, the oval film would fill up the space. Now, when the angle of the two wire frames is made narrower instead of wider, the oval narrows till, at 45°, it is a line, and in one moment the system has changed: the oval stands between the wider angle just across its old position and at right angles to it.

A still more remarkable change takes place when a bubble is blown upon the oval film, the lines being at right angles to each other. When it reaches the proper size, all the films disappear, and a hollow curvilinear cube is formed, each side curving out from the wires which define its vertical edges. At the top and bottom the wires make a cross on the film; in each of these triangular spaces four summits appear; colored rings form around them; a black spot shows in the center of each summit, and the bubble bursts. If the wires are held straight up and down when the bubble bursts, the old system of films will start into being again, as if it had left its ghost behind it to recover the elements which the bubble had appropriated.

Dr. Sloane, in his "Home Experiments in Science," gives some beautiful figures. A wire is bent in a spiral, with one end turned straight up through the middle like an axis. Dipped in the fluid, it gives a single spiral film curving around the central wire as a spiral staircase curves around its central pillar. He also gives some very simple and interesting experiments showing the traction of films, requiring no special apparatus or fluid, and so within the reach of every one. All the frames used in this article were made of thin copper wire bent into shape with the fingers or a pair of pliers. Of course, if the wires are soldered instead of being twisted together, and are covered with a thin film of paraffin by rubbing a so-called wax candle on them and then holding the frame above but not too near a bed of coals, the films will last longer; but that is the only difference.

The wonderful traction of films is shown by the recent experiments with oil upon the waves in a storm. The oil, of course, does not still the waves, but it converts the combing waves, so dangerous to navigators, into a comparatively harmless swell. It is the traction of the film which prevents the wind from drawing the water up the incline of the wave and sending it jetting upward to fall over in a comb. A film of oil $\frac{1}{500000}$ of an inch in thickness will hold the wave of water driving before a gale so that it can not break into spray.

The closing words in Brewster's experiment on the revolving rectangles of wire bring us to another remarkable though famil-

iar fact in regard to films—their wonderful and changing colors, what in scientific language is called "the colors of thin plates," because the same effect is produced in many cases where "film" is not exactly the word to use.

The colors of soap-bubbles furnish one of the most triumphant vindications of the wave theory of light, and offer to its opposers one of the hardest possible nuts to crack. A brief explanation of the wave theory of light and interference, so far as it bears upon our subject, will, it is hoped, be pardoned. It is an idea so familiar to those who have studied physics, and yet so difficult of conception to those who have not, that a few words seem necessary in a popular exposition of the colors of films.

Light is, of course, our name for the sensation, but back of the sensation there lie the physical conditions which are its cause. The theory of Newton, that light is caused by minute particles of matter shot out from the luminous body, stood the test of the simpler phenomena; but, when it came to the explanation of soap-bubble colors, his theory, even with the marvelous ingenuity which he brought to bear upon it, broke down. If light were matter, it is impossible to see how one light can be added to another light and produce darkness, which is sometimes the case; while, if it were motion, we can readily see how motion may be added to motion, and the result be rest. A sound can be so added to a sound as to produce silence, but the more familiar illustration is with waves of water. Two stones dropped into water will produce waves, and where these meet there are points at which the water remains at its original level. This is because at these points one set of waves tends to raise the water while the other set tends to lower it, and between the two it remains where it originally was. This occurs in some parts of the ocean where the tidal wave sweeps around an island and meets, one wave being half a length behind the other, in which case they simply neutralize each other. Where the crest of one wave would have been, the trough of the other would have been at the same time, and between the two impulses in opposite direction at the same moment the water remains unmoved, and there are no tides.

Darkness corresponds with this unmoved plane of water, and with silence in the case of sound-waves. If light were simple waves, as a result of such interference we would simply have darkness, and as a result of partial interference we would have all the gradations from darkness to light; but a light-wave is not a simple undulation, it is made up of innumerable vibrations of various wave-lengths, each of which corresponds with a color or tone. The resultant of all these motions combined is white light. Extinguish one rate of vibration, say the smaller waves which cause the sensation of blue, and we have a wave the resultant of all that

is left behind, which will be yellow. Color is a partial extinction of light—not of light as a whole, but a suppression of one of its constituents. If you take a yellow glass and allow the light to fall through it, you will find it transparent; in the same way a blue glass is transparent; but if these glasses are the complementary blue and yellow color, and placed one on top of the other, no light comes through them. The yellow glass sifts out all the blue rays, and the blue glass sifts out all the other rays, and no light can get through. If the colors are not pure, it is usually because the yellow has some green in it, and so has the blue. Neither the yellow glass nor the blue is competent to sift out these rays, so we see green come through them both. This is the case in mixing blue and yellow in paints: the resulting green does not come from the mixture, but is the sediment—you might almost call it—left after the pure blue and pure yellow have neutralized each other.

It is clear that, if two waves can be made to set into vibration the same medium at the same time, and from almost exactly the same center, one of them being a half-wave or several half-waves' length behind the other, we shall have, as in the case of water and sound, no movement, or darkness. If there is not exactly a half-wave's distance between them, some color-waves will neutralize each other and be extinguished, and we shall get the complementary color—the resultant of all that is left unneutralized.

This is the cause of all the flitting and changing colors in soap-bubbles, mother-of-pearl, peacocks' plumage, opals, and iridescent glass. By some means certain vibrations have been extinguished by interference, and we see the resultant of the rest. Whenever light goes from one medium into another, even when both media seem perfectly transparent, there is a partial reflection from the surface where the media meet. Hold a pin against the surface of a piece of glass (unsilvered plate glass is the best): you will see two faint reflections of the pin, one from the front surface of the glass and one from the back, and yet the main part of the light reflected from the pin goes through, as you can easily tell by looking through the glass at the pin. So it is with a soap film: when light falls on it, most of it goes through, but there is a slight reflection from the outer surface of the thin lamina of soap-suds and another slight reflection from the back of it. The two sets of reflected waves start from points so very near each other that they both act on the medium in different directions at the same time and in the same place, and we have color.

If light went forward like a regiment of soldiers in line, there might be just as much interference from the plate of glass as there is from the film of soap-suds; but it does not—it goes out in

circular or, rather, spherical waves in every direction from the starting-point. It is only waves of light which are reflected back from two points very, *very* near each other, which produce the colors of interference. Circles which do not have the same center cut each other only at two points; but, the nearer the two centers are, the more nearly the circumferences coincide. When the light comes back colored from a piece of mother-of-pearl, it is because the waves are reflected back from lines so close together that you can not see them, except under a very high power of the microscope, and so they interfere. Metal may be ruled with lines that give back the same sort of color, and perfect impressions in black sealing-wax of the colored pearl will show colors in the same way.

The colors which flit over the surface of a soap-bubble each tells the story of the thickness of the film at that point. These films are exposed to the movement and drying effects of the air, and to the irregular puffs of air entering from the mouth in blowing them; but if a film can be secured from these influences and allowed to become gradually and evenly thinner, even and regular colors appear. Blow a soap-bubble in a watch-glass filled with the soapy fluid. Let it sit in a saucer in which there is also some of the fluid, and cover with a clear glass tumbler the instant the bubble a little overhangs the watch-glass. The soapy fluid in the saucer prevents the air from getting in or out of the tumbler. Such a bubble blown from soap-suds made of distilled water and white Castile soap, which had been standing a very long while and become crystal clear, lasted for three hours and a quarter. It had no colors upon it when covered. They began to form at once: broad bands of pink and green slipped down from the apex; then came closer and more vivid rings of color; at last a black spot appeared, which grew in size. In the long-lived bubble just spoken of, the whole upper part became a metallic gray, covered with clouds of darkness and velvety black spots, the colors being crowded from the apex down to the edges. That these appearances are all due to interference is proved by the fact that, when the light by special means is prevented from reflection at one of the surfaces of the film, the color disappears.

There is no special advantage for home experiments in having a bubble last so long. Very much the same changes occur in a bubble which lasts for half an hour as in one that lasts for three hours, only they occur more quickly.

The colors of films are rarely, if ever, pure prismatic colors; they are the resultant of certain colors left after the extinction of others. Various shades of green, from almost gold to the intensest emerald green, orange dusky with red, red magenta-colored from the admixture of blue waves, and so on, are the colors seen.

Another simple and very interesting experiment is to twist a copper wire into the shape of a tennis-racket or battledore, dip it into the fluid and set it upright under the tumbler. If the saucer is partially filled with yellow beeswax, melted and allowed to harden, this can be very easily done. The colors in this case come down in bars, in the same order as they did on the bubble; the black spot is much larger and more irregular in shape. In one instance, with a simple soap solution, this spot of intense black covered three quarters of the frame before the breaking of the film. Many films may break before one is secured which will last so as to show these effects.

The cause of these regular rings and bars of color is that the film gradually thins from the top, by the slow streaming off or evaporation of the suds from the film, and for each definite thickness a definite color appears. The black spot which comes last of all shows that the film at that place is just one half a wave-length of light in thickness, a size entirely too small for our conception, though it can be told in numbers. The length of a wave of red light is about $\frac{1}{31000}$ of an inch, and of all the other colors smaller.

The circulation and changes in the film are most curiously revealed by the movement of flecks of color on its surface.

There are other ways of making inequalities in the film, which are revealed by the colors. A little instrument, called the *phoneidoscope*, which may be either bought or very easily made, shows most beautiful figures which start into shape in answer to musical notes sung or words spoken into it. It is in all its forms a modification of, or improvement upon, this idea: an inch tube of India rubber of any length, with a funnel on one end and a mouth-piece on the other, diaphragms of thin metal or varnished cardboard being placed across the mouth of the funnel with holes of various

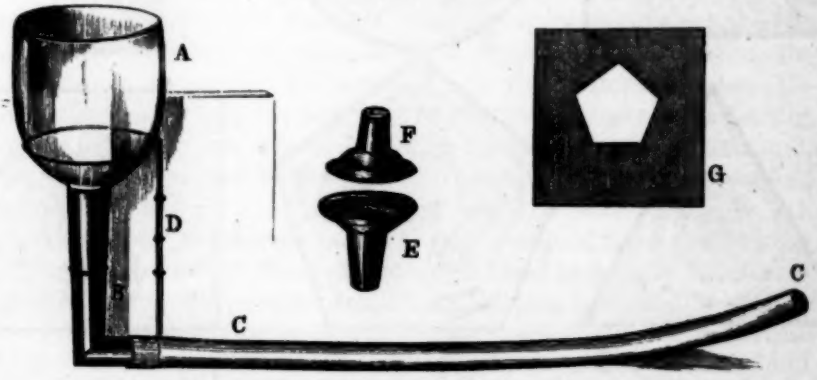

FIG. 8.—PHONEIDOSCOPE.

A, bell-glass; B, elbow; C, India-rubber tube; D, wire support; F, upper half of mouth-piece; E, lower half of mouth-piece; G, diaphragm.

shapes cut in them to sustain the film. A very satisfactory one may be made with very little trouble and at slight cost: three feet of inch rubber tubing, a bell-glass, such as is used to shade night tapers, some pieces of cardboard or thin brass, which can be cut with the scissors, and an inch tin elbow, used in speaking-tubes and costing three cents. Fit the parts together as in Fig. 8. The diaphragms should be blackened and varnished if of cardboard; the holes in them can be triangular, square, round, or of any geometrical shape. A film is drawn across the hole in the diaphragm; it should be set upon edge till the colors are established, then it is to be laid across the mouth of the bell-glass, and into the other end of the tube notes can be sung; but the breath must not be inhaled or exhaled carelessly, or the film will be broken.

A closed mouth-piece may be made by filing off two tin toy trumpets two inches from the *open* end. Over one tie a stretched membrane of India-rubber sheeting, such as dentists use, or fasten

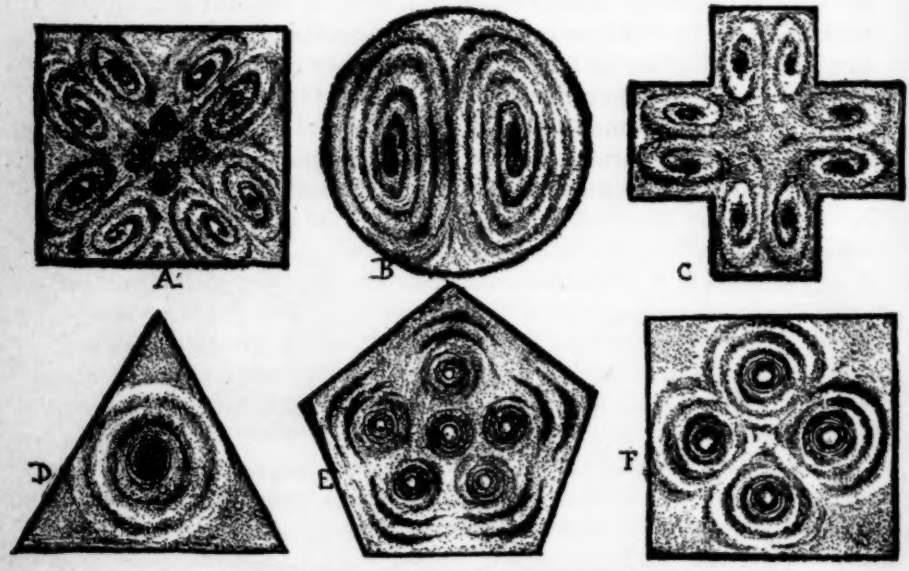

FIG. 9.—FIGURES ON FILMS IN PHONEIDOSCOPE.

A, B, C, forms whirling and evanescent; D, E, F, forms which remained for some time after the vibrations of film ceased.

with paper a thin sheet of mica, E, or even tough, strong letter-paper may be used. Hold the second trumpet, F, reversed against this, and sing into it.

The colors and figures on these films, if one is patient and learns how to use the voice, are simply incredible—they are so wonderful and gorgeous. Fig. 9, A, B, C, D, E, F, show the forms obtained on several diaphragms with the home-made phoneidoscope described above, some with the closed mouth-piece

and others by simply carefully singing into the rubber tube. The colors change constantly, and are so rich and gorgeous that they seem to have lost their transparency and to be metallic plates, except for their streaming, swirling colors. The diaphragms should, as was said before, be blackened, and the film seen projected against a black background. I simply use a piece of black material placed behind and a little below the bell-glass on which the diaphragm rests.

These interference colors do not require a film of any special substance, or, indeed, of any substance at all. The air between two plates of clean, clear glass, pressed together and worked with the fingers till they are as close as possible, gives beautiful rings and fringes of color. A crack in the center of a block of clear ice, where there is not even air, but only empty space, or, rather, the ether that fills all space, gives out gorgeous colors of interference.

The colors of iridescent glass are due to interference. In its manufacture, by some chemical means, the surface film has been made different from the glass below, and so acts as the soap film does, and gives out its lovely tints. A drop of turpentine on the surface of water on a black tray shows fringes of color from the same cause.

One of the most beautiful examples of interference color may be seen at the Metropolitan Museum of Art in New York, in the Cesnola collection of ancient glass. Originally this glass was evidently ordinary transparent glass. From some cause the surface has been acted upon till it lies in thin films one upon the other, sending back to the eye the most gorgeous interference colors. By the courtesy of Dr. Isaac Hall, the curator of the museum, I was enabled to examine some fragments of this glass microscopically.

The whole surface is made up of a series of films of the most exquisite delicacy. There are tiny cavities united by a network of lines from which the decomposition has spread laterally in every direction. Flakes come off with the lightest touch, so thin that it seems impossible they should be capable of subdivision, and yet a good two-thirds glass (about one hundred diameters) shows it to be made up of a number of superposed plates. The fact that the color of this glass is due to interference is proved by putting a drop of alcohol or oil upon a flake, when the colors disappear or are entirely changed. As the liquid dries, the colors gradually come back.

The beauty of this glass under the microscope is simply indescribable. Gold and silver, exquisitely wrought, and vivid with every known jewel, would be tame and colorless beside it (Fig. 10, A). The films, as they come off, are in many cases not ordi-

nary flat films; the outlines are sometimes very singular, being made up of most eccentric curves in all sorts of combination. In one or two instances these scales overlapped, showing that the disintegration had taken place in a spiral direction (Fig. 10, B). This world of beauty, in both colors and form, was found within the area of one square inch or less, on a small fragment of no special brilliancy to the naked eye.

Brewster describes, in the "Transactions of the Edinburgh Royal Society," some specimens of ancient decomposed glass, but they must have been in a much earlier stage of decomposition than the Cesnola glass, judging from the figures and descriptions given. He states

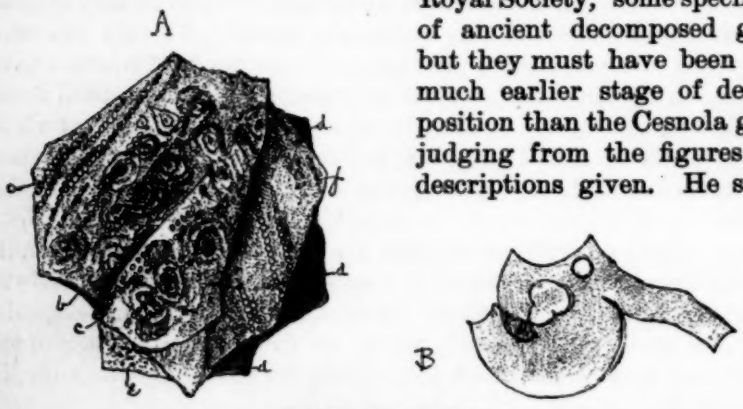

FIG. 10.—CESNOLA GLASS.

A. *a*, emerald-green, with strings of bubbles light-green and brilliant, like pale emeralds; *b*, bronze-gold ground, spots of violet, and bronze-gold rings, ruby, pale vivid blue, and deep sapphire blue; *c*, partly scaled film, vivid violet, toning down, with spots as above; *d*, deep violet-blue, like the sky on certain nights; *e*, speckled gold; *f*, exquisite violet, with bubbles like pearls, only shaded violet tone.

B. Shape of violet layer as it came off, very thin.

that the experiment had been made of submitting glass to powerful solvents, when, in a short time, circles and other forms, centers of decomposition, began to appear. Here was probably the suggestion which has since been followed in the manufacture of our modern iridescent glass. In a piece of iridescent glass, brilliant at first, but which has been growing more brilliant for several years, I find a number of distinct centers of disintegration, showing the process, whether by art or by time, to be identical in kind.

THE question involved in the problem of air navigation is regarded by Mr. E. N. Lewis as simply one of increasing power without increasing the weight of the apparatus by which the power is applied. The supposition that the vehicle must be lighter than the air, on which experiment has mostly proceeded, is a mistaken one. "A bird can fly, not because it is comparatively light in weight (for it is not), but because it is strong." The successful air-ship will be a large structure, very light in weight compared with its strength, but many times heavier than the air it displaces, and propelled by machinery capable of developing enormous power. "The skill which has produced . . . the modern bicycle will not find the task of designing such a structure too difficult."

THE PSYCHOLOGY OF PREJUDICE.

By G. T. W. PATRICK, Ph. D.,
PROFESSOR OF PHILOSOPHY IN THE STATE UNIVERSITY OF IOWA.

THE rapidly enlarging field of modern psychology makes it possible to discuss some questions not before attempted by students of mental science. There is, however, even yet, one apparently simple problem in mental pathology which the most hardy philosopher would hardly hope to solve. This problem is to determine, by analysis of the soul, the causes, symptoms, and cure of narrow-mindedness, or mental bias. Such a research, if aught could be made of it, would be as fascinating as it would be fruitful.

My present attempt is less ambitious. It is to trace out some primary laws of psychic activity in their bearing on that condition of mind known as prejudice. I shall not here allow myself to be entangled in a metaphysical puzzle by attempting an accurate definition of prejudice. To define it as deflection from truth would be to raise the ancient question, What is truth? It will be quite sufficient for my purpose to consider prejudice as individual deviation from the normal beliefs of mankind, taking as the standard the universal, the general, or the mean.

The chapter in modern psychology which furnishes the principles in quest is the chapter on apperception—really only another word for attention. All knowledge is the result of the union of two factors, one objective and one subjective. To know anything is to refer it to something known before. In every cognition there is a union of the group of sensations composing the object with a group of ideas previously acquired and now recalled. Knowledge is classification. The class is within us; the thing to be classified is without. A piece of sugar lies before me on the table. I perceive only that it is a white object of a certain form. I apperceive, by means of the group of ideas previously associated with such white substances, that it is also sweet, hard, heavy, soluble in water—in fact, that it is sugar. The inner group of ideas varies indefinitely in complexity. Closely related ideas may be altogether wanting, as when one sees, for instance, a horse for the first time, and can only ask, What is that thing? or, What is that animal? One with more experience—that is, with more related ideas—apperceives that it is a horse. A jockey, however, apperceives all his "points"; a zoölogist still more. We say that the jockey or zoölogist really *sees* more in the horse than the ignorant man, yet the image made upon the retina of the eye is the same in each observer. Similarly, in

reading, we cast the eye rapidly down the page and, although we do not see one half the words, or a fraction of the letters, yet we catch the sense. If it happens to be a letter from a well-known friend, we read also, as we say, between the lines. Really we read out of our own heads.

The subjective or *a priori* factor is simplest, therefore, when, as in the cases given, it is merely the class notion, horse or sugar; it is most complex when it represents, for instance, a whole system of astronomy, as when, in a falling body, there is apperceived a law of gravitation. But, simple or complex, it follows, first, that unless there be an inner group of ideas to which the object may in some way be referred, knowledge of it is impossible; and, secondly, that the character of the resulting knowledge depends upon the character of the inner group of ideas. You and I, therefore, see everything to some extent differently. You see things from the standpoint of your previously acquired groups of ideas; I from mine. Strictly, no two persons can see the same thing in the same way, for it can never happen that two persons have precisely the same groups of ideas relating to any subject. These depend on our past experience, on our education, on the beliefs of our times, on our various sects or parties, on our pet theories, our interests, and our desires. Here is a simple illustration. Suppose an artist and an engineer, standing side by side overlooking a tract of country. What they perceive is the same; what they apperceive is wholly different. To the engineer the country presents itself as a possible line for a railroad, with here advantageous grades and there economic bridges. Before the artist is spread out a landscape, with light and shade and harmony of colors. Suppose, again, a plot of level ground in the suburbs of a city. A college student riding by apperceives it as a possible ball-ground; a young girl, as a tennis-court; a speculator, as an addition for town lots; an undertaker, perhaps, as a possible site for a cemetery.

In the primary laws of knowing, above stated, we discover the ground principles of the psychology of prejudice. The results may be summed up in the form of two laws:

1. *We see only so much of the world as we have apperceptive organs for seeing.*

2. *We see things not as they are but as we are—that is, we see the world not as it is, but as molded by the individual peculiarities of our minds.*

Applications of the first law I shall state briefly; of the second, more in detail. The eye is limited by its structure to the reception of ethereal vibrations between the colors red and violet. The ear converts into sound only air-vibrations of a limited rapidity. Just so the mind, in its reception of knowledge, is

limited by the quality and amount of its previous acquisitions. "No man," Emerson tells us, "can learn what he has not preparation for learning, however near to his eyes is the object. A chemist may tell his most precious secrets to a carpenter, and he shall be never the wiser—the secrets he would not utter to a chemist for an estate. God screens us evermore from premature ideas. Our eyes are holden that we can not see things that stare us in the face, until the hour arrives when the mind is ripened; then we behold them, and the time when we saw them not is like a dream." Instinctively, therefore, we seek the mental food that our minds are prepared to digest—that, namely, which is most clearly related to what we know already. In conversation, notice how people brighten up when you tell them something that they know already, especially if it is something they have long believed or themselves discovered. In society we know how to make ourselves agreeable by speaking to each person on the subject of his peculiar interests. If we are wise, we shall engage each person in subjects of conversation about which he is best informed. By so doing we can not only make ourselves agreeable, but lay by a stock of useful information at the same time. Such a course is by no means easy. We fall naturally into the vice of parading our own knowledge, and we like to hear others talk, not of their interests, but of ours. Sometimes persons in conversation act simply as foils each for the other. I listen to your stories only that you in turn may listen to mine; and in the next company I tell not the ones I heard, but the ones I told before. Thackeray, in "Henry Esmond," hits upon this human weakness. "They emptied scores of bottles at the 'King's Arms,' each prating of his love, and allowing the others to talk on condition that he might have his own turn as a listener."

We like also to read that which favors our side of a question. The Republican subscribes for a Republican newspaper, and the Democrat reads the organ of his party. In the last political campaign it was no doubt true that advocates of free trade or of tariff reform, and advocates of protection, read for the most part literature favorable to their respective views. The churches plead for greater consensus of opinion, yet the Methodist subscribes for a Methodist paper, the Baptist for a Baptist paper, the Roman Catholic for a Catholic paper. In general we read the organ of our own sect or party. There are, of course, some valid economic reasons for so doing. I shall speak of these reasons below. But, if truth alone were sought, the plan we pursue would be the worst plan possible. Sometimes even we indignantly refuse mental food that might serve as a corrective of our possible one-sidedness, instinctively avoiding that which we feel can not be assimilated without a dangerous readjustment of our mental possessions.

The skeptic in religion opens a book on Christian evidences, only to close it in haste when he perceives its trend; while the pious believer, who picks up the work of Strauss or Renan, drops it like a burning coal. We avoid books, men, sermons, society, that are not, as we say, congenial. Hence the trouble we have in getting our books read by the very people for whom they were written, or in getting our articles printed in the journals that circulate among the readers we desire to reach. The preacher prepares a vigorous sermon for "sinners," but he preaches it to his own devout people; the "sinners" are not there.

Our psychological law of prejudice thus developed teaches us that, since we seek not for what may correct our possible errors, but for what will confirm our already acquired opinions, our mental life always tends toward intensification or *involution*. Evidently this tendency of the mind toward involution will grow with age, and our every-day experience confirms this deduction. Teaching new tricks to old dogs is easier than giving us new apperceptive organs when middle life is past. The old man changes his politics rarely, his religion never. He lives from within. The mind becomes more and more a microcosm. The cerebral tracts show well-beaten paths of association. The brain becomes hardened and fixed. "An old man," says Dr. Holmes, "who shrinks into himself, falls into ways which become as positive and as much beyond the reach of outside influences as if they were governed by clock-work." The brain, he continues, has its "systole and diastole as regular as that of the heart itself."

> "Minds roll in paths like planets: they revolve
> This in a larger, that a narrower ring,
> But round they come at last to that same phase,
> That self-same light and shade they showed before.
> I learned his annual and his monthly tale,
> His weekly axiom and his daily phrase.
> I felt them coming in the laden air,
> And watched them laboring up to vocal breath,
> Even as the first-born at his father's board
> Knows ere he speaks the too familiar jest
> Is on its way, by some mysterious sign
> Forewarned, the click before the striking bell."

The older we get, the larger becomes the subjective factor of knowledge and the smaller the objective. We are, as said the obscure sage of Ephesus, like those asleep, withdrawn each into a private world of his own. We can now understand that state of mind described by the word "confirmed." We hear of a confirmed pessimist, a confirmed protectionist or free-trader. Sometimes we apply the word without shame to ourselves, saying that experience has confirmed us in this or that opinion, not know-

ing that to a considerable extent we have selected our own experience.

Our second law affirms that we see the world not as it is but as modified by the individual peculiarities of our minds. The illusions that result are Bacon's well-known "idols of the den," doubtless the most fruitful of the four sources of error pointed out by that clear-headed philosopher. For our starting-point we may turn again to physics and physiology. Vibrations of the luminiferous ether of varying rapidity are perceived by the eye as a harmony of colors. Vibrations of the air of varying rapidity are perceived by the ear as a harmony of tones. Unless, now, we are prepared to say that the *colors* red or green, or that the *tones* a or a′, are like or in any way similar to the *motion* of the ether or air; unless, further, we are prepared to say that, corresponding to the subjective *harmony* of colors and tones which we feel, there is an objective *harmony* of motions in the ponderable stuff, then we must admit that we have here cases of the great primary illusion of a phenomenal world of ideas like a noumenal world of things-in-themselves. With this ancient problem of perception we are not now concerned, but it serves as an illustration of our mental law of apperception. As the eye and the ear, each according to its structure, make over the manifold motions of the external world into sensations of light and sound, so the mind makes over the materials of knowledge into this or that product according to its peculiar constitution. Observe, however, this difference between the two cases. While the eye and the ear vary little in structure in different individuals, the variations in mental structure are endless, being determined by our environment, education, and inherited peculiarities. Color-blindness is comparatively rare and limited to a few colors; psychical blindness, in a greater or less degree, is a defect no man is free from.

The simpler illustrations of this law need not detain us. We put any new phenomenon into that class of our previous notions which it most closely resembles. A child who sees a cow for the first time calls it a horse, if familiar with horses. The same plant may be apperceived by a girl as a flower, by a farmer as a weed, by an old woman as an herb. The story of the precocious boy is in point. He sat under a tree as three strangers passed by. The first said, "What a fine stick of timber!" "Good-morning, carpenter," said the boy. The second, "What excellent bark!" "Good-morning, tanner." The third, "What a beautiful tree-top!" "Good-morning, artist." He had correctly interpreted their vocations from their manner of apperceiving the tree. Our habits of thought, once started, grow on any food. We go by chance to hear a lecturer of an opposite party or sect, and come away confirmed in our *own* views. This law of mental inertia

tends constantly to produce one-sidedness. Nature strives ever to rectify this tendency by presenting to us an unsorted variety of details, and succeeds in keeping most of us within the bounds of sanity, though not of perfect balance. "The complexity of our environment," says Ribot, "is our safeguard against automatism." But our ideas are ingrowing, and need to be constantly watched and corrected. Insanity is a matter of degree. When the "fixed ideas" which few of us are without pass a certain point and get too obtrusive, we become monomaniacs. Men of one idea, men of mental bias, narrow-minded men, present milder cases of the same disease.

Fruitful illustrations of this law may be seen in the *systems* of thought that have prevailed since the days of Pythagoras. Systems of words would be a better name for many of them. As in our seeing, so in our thinking, we are limited by the apparatus that happens to be at our command. For most of us, at least, the available apparatus for constructing a philosophical system is a philosophical vocabulary. From this fact and the further one that these vocabularies are largely inherited from the schools, it results that the apperceptive organs of metaphysicians are wofully inadequate to the task they undertake, namely, the cognition of ultimate realities. It is no wonder, therefore, that these realities have been persistently apperceived under so many different forms in the various metaphysical systems, supported by so many "hide-bound adult philosophers." Many a well-meaning philosopher has got caught in the swing of a certain terminology, till his thoughts have become slaves to the movements of his tongue. We are reminded of Aristotle's categories, Kant's map of the mind, Comte's three stages, Hegel's thesis, antithesis, and synthesis, the absolute and the finite, subject and object, mind and matter, body and spirit, noumenon and phenomenon, real and ideal, rational and empirical. This is the "tyranny of formulas" from whose iron rule science is now escaping, but which is still the terror of philosophy and religion.

The danger of words and formulas may be well illustrated further by the mischief made in philosophy by the presence of negative terms. These are the words which in the finished systems of the philosophers mark, we may say, the absence of thought. We recall the "*In*finite" of Zeno and Kant, the "*Ab*solute" of Fichte and Hegel, the "*Supra*-essential" of Pseudo-Dionysius, the "*Un*conditioned" of Hamilton, the "*Un*knowable" of Spencer, the "*Not*-ourselves" of Matthew Arnold, the "*Un*conscious" of von Hartmann, the "*Im*mortality" of Christian believers, the μὴ ὄν of the Greeks, and the "*Non*-being" of the Hegelians. These represent the unfathomable places in thought, which we bridge with a negative term and pass on blithely as before, but

presently find ourselves using them as conceptions regularly formed. In Goethe's well-turned phrase:

> "Denn eben wo Begriffe fehlen,
> Da stellt ein Wort zur rechten Zeit sich ein."

But if prejudice prevails in philosophy, what shall we say of religion? The race as a whole is divided into a large number of religious systems, and each system into sects. Every individual apperceives the "eternal truths" from the standpoint of the sect in which he was educated. Rarely does he change from one faith to another, and when he does so it is not often for his peace of mind. Such an "Exodus from Houndsditch," in Carlyle's homely phrase, is accomplished only "in a state of brutal nakedness, scandalous mutilation." Why? Because religious ideas are deep-seated and fundamental. To receive into the mind a group of new and foreign notions of such a kind requires a breaking up and readjusting of the old order such as few can undertake with safety. The very psychological laws that we are studying, however, may teach us that these world-wide differences in opinions are not destructive of the eternal verities of religion, but only that these verities are distorted when narrowed down to fit our particular systems and our individual capacities.

There is a curious science called the science of interpretation, whose business it is to translate the facts and thoughts of the world into phrases comprehensible to a mind limited to a certain system of ideas. Have we ever stopped to think what a confession of shame such a science carries on its face? To interpret is, in some sense, to change, to distort. An instructive illustration of this branch of learning may be seen in hermeneutics, or the science of the interpretation of the Scriptures. Never in any literature were thoughts expressed in so simple, straightforward, and honest language as in the books of the Bible, or in language less in need of interpretation. What this science really has in hand is the pitiful task of fitting a vast variety of thoughts into the limited number of forms of some system of theology. So, everywhere, it is a mistake to interpret things. It is better to let Nature carry on her work of rectification, by allowing the bare facts of the world to project themselves freely against our minds and be perceived as they are, or make for themselves apperceptive organs.

Interpretation leads to over-interpretation. This evil becomes prominent in connection with those studies which are not yet exact sciences, such as sociology, ethics, metaphysics, and theology. Here, as we know, we very often have to make an allowance for the "personal equation" of the author—unless, unfortunately, belonging to the same party, sect, or school, we have

blindly accepted him as a guide. We understand that he writes from a certain *standpoint*, and that unconsciously and inevitably he will see things, not just as they are, but as tinged by his own subjective light. Where, for instance, shall we find a perfectly just history of philosophy? Not in Schwegler, who glances over the past through a pair of thick Hegelian spectacles; nor in Lewes, who apperceives the opinions of thinkers with a positivistic bias. Theology is quite a different science as presented by a St. Augustine and a Pelagius, by a Protestant and a Romanist. The Socrates of Grote is not the same man as the Socrates of Cousin. Jesus, even, is seen in an entirely different light by Fleetwood and by Renan. The Greek thinkers, especially Aristotle and Plato, have suffered much at the hands of modern writers, being used as props to bolster up every man's system of science or philosophy.

Over-interpretation is really only the logical outcome of another wide-spread evil, that of over-systemization. This is a prevalent modern vice. It is the abuse of classification, or the scientific method. It is the tendency to group under any outlined system or theory more facts than properly belong to it. We fall in love with our favorite theory, and it seems to us to possess exaggerated virtues, and to be able to explain all phenomena. Darwinism in biological science, utilitarianism in ethics, and Hegelianism in philosophy, are examples. The latter is a very beautiful illustration of over-systemization. Hegel, with his thesis, antithesis, and synthesis, fondly thought he had spread a net that should capture the universe. But the strain appears to have been too great, and already we see the ruins of a great collapsed philosophy. Over-systemization is apparent also in the present rage for publication, especially in Germany. Every university man must publish a book, and every book must present either some theory or the results of some original research. Under these circumstances, it is not surprising that the demand for new material exceeds the supply. The result is, that the author falls back upon his own mental resources. He makes a new and original hypothesis and apperceives his facts to fit his theory. Adopting, as it would seem, the maxim that it is better to be original than reasonable, it is considered no disadvantage if the new hypothesis is somewhat fanciful and startling, as for instance that Schiller, not Goethe, was the author of "Faust," or that Shakespeare's plays were written by Bacon.

I have explained the narrowing effect of "schools" and systems, and the mental bias which results from over-systemization; but the use as well as the abuse of systems must not pass unnoticed. There is good in them as well as evil. Trendelenburg says that a system is as necessary for a thinker as a house. We

must get our knowledge into some sort of unity, otherwise it can neither be retained nor used. The Ptolemaic system of astronomy was far better than none; it served as a framework for a great body of facts, distorted though they were by the false theory. We are lovers of systems. Most of us prefer unity to verity. We want order and discipline among our ideas. Of absolute truth we can not speak; of order and consistency we may. Any new system may find numerous adherents, if only it be presented in the threefold form of unity, consistency, and repetition. It is easy to understand this love of systems. They save us from the inevitable mental bankruptcy which would result from the influx of a mass of uncoördinated impressions. Grant us a system, all complete in its several compartments, where we can pigeon-hole each newly acquired fact, and peace and harmony reign within. No matter if the system be so narrow that we can dispose therein only a limited number of impressions; if only we have confidence in it, all heterogeneous elements we may cast out as "error." We love harmony and hate antagonisms. It is mental economy, therefore, for us to read the organs of our sects and parties, to converse with those with whom we sympathize, to listen to that which we believe already. Great historical disturbances bring out systems. It is in this way that we get ourselves ready for troublous times. A system is a kind of mental fortress, a vantage-ground from which to scrutinize each new idea, and apperceive it as a friend to be received or an enemy to be, on *a priori* grounds, repelled. System-forming is thus the process of mental involution, which is the law of individual minds, as evolution is of the mind of the race.

Mental involution shows another phase in *habit*. Habits are well-knit associations. They make us machines, committed forever to a determined manner of acting and thinking. A habit is itself a mental bias. Stereotyped and inherited, it becomes instinct, where we see the full fruition of the involution movement and the dead level of automatism. From this point of view, instinct has been well called "lapsed intelligence," if by intelligence we mean power to adapt ourselves to new surroundings and to avail ourselves of new impressions. Habit is opposed to progress. In history, our reformers—Jesus, Savonarola, Luther—have been habit-breakers. Genius, too, is only the name of that disposition which rebels against the law of mental involution, breaks away from systems, and goes out in search of the objective truths of nature. Thus, side by side with the involution movement, we find the evolution movement. In the animal kingdom, it is represented by the persistent but mysterious tendency toward *variation;* in human history, by the comet-like appearance of the reformer; in art, by the lawless product of genius. All these are

factors in the upward world-movement which saves us from the stagnation of the relentless law of habit.

But habits, like systems, have their good side. They enable us to do a vast number of actions with the minimum of attention and the least expenditure of nervous energy. Education consists largely, as has been said, in making habitual as many good actions as possible. The training of domestic animals is purely the formation of good habits; the training of children is largely so. Every time we form a good association and send it down into the region of the unconscious, we practica mental economy. Habits, therefore, are at the same time our salvation and our damnation. This is the great dilemma in education. Extremists like Rousseau, impressed with the danger of habits, condemned them all outright. Perhaps we may say that it is the abuse of habits, the falling into fatal ruts, that constitutes our prevailing sin.

The laws of prejudice that we have examined naturally suggest one or two questions. Is there any escape from this narrowing of mind that accompanies the hardening of the brain? If not, are there any pedagogical principles the application of which in educational systems may retard the involution and hasten the evolution movement? It is not my purpose to attempt to answer these questions here; but, if the first one must be answered in the negative, the latter may certainly be answered in the affirmative. Our psychological principles have already shown us the direction in which the solution of this problem must be sought. There must be persistent emphasis of the objective factor of knowledge. The senses, the primal source of all our knowledge, must be kept open and alert. This is vastly more difficult than at first appears. The man prejudiced by his interests has his eyes and ears open, and yet, being open, they are shut. More than twenty centuries ago an old Greek philosopher said, "Eyes and ears are bad witnesses to men having rude souls." To escape mental bias, we must not only have our senses open to the outer world, but we must apperceive this world as it is, not as warped by our receptive faculties. But, however excellent this advice, it is as impossible for us with minds already formed to follow it as to see the ultra red or violet colors with our eyes constituted as they are. The remedy is to be found in education, especially of the young. Fortunately, we live in an epoch of objective education. The training of the senses, thanks to the labors of Rousseau, Pestalozzi, Froebel, and their disciples, and thanks to the retroactive influence of the physical sciences, is now the great central thought in pedagogical systems. Unfortunately, it is still too largely theory and too little practice. In our primary as well as in our secondary schools we slip back too easily into the lazy scholastic, deductive methods. The tendency, however, is the other way.

Our free press, also, and our free speech are great educators. In these days we are compelled to see and hear and think. The narrow-minded man is unhappy and distracted. He is no longer protected in his little system by college or cloister walls. A myriad unwelcome facts peer in at him from every side—from the circulating library, from the interesting novel, from the omnipresent and iconoclastic newspaper. The man of mental bias is veritably a victim of persecution. Optimists tell us that the world is growing honest. I am optimist enough to believe that it is growing broad-minded. Perforce it must. The air is full of everybody's ideas. They circulate everywhere and act as a series of incessant shocks wherever they find a mind too narrowly planned to admit them. Hence men are beginning to avoid systems as the cause of more friction than they save. They are willing to sacrifice a narrow love of unity and consistency for a broader harmony with the spirit of the age.

What is likely to be the result of this general breaking up of old unities, systems, habits? An increase of insanity? By no means. Insanity proceeds from the opposite movement, from the involution of the mind upon itself, till fixed ideas can no longer be rectified by objective facts. The results will be good and bad: good, in encouraging inquiry and in substituting the love of truth for the love of consistency; bad, in discouraging a certain moral earnestness and enthusiasm which are the outgrowth of strong conviction, for the narrower is one's system of thought, the stronger often are one's convictions of its truth and importance. The extreme form of this union of prejudice and intensity we call fanaticism. If not in fanaticism, at least in enthusiasm, there is an element of good which we must not overlook. Men possessed with one idea are men of action. Enthusiasts carry forward great movements. The development of the intellect is the weakening of the will. Children and animals act out every thought. Education is a training in the inhibition of movements by the higher intellectual processes. The man of many-sided mind finds every volition "checked" by some antagonistic idea. The correction of mental bias, therefore, will result in a certain loss of spontaneity. But progress will not suffer. If we move more slowly, it will be more surely. What we lack in enthusiasm we shall make up in balance.

"THE great fault of non-manual training schools," says Prof. C. M. Woodward, "is their haziness. The pupils look at multitudes of things but do not perceive them. Having eyes, they see not; and having ears, they hear not. There is too much that is dim and muddy and feeble. Substances elude the grasp; shadows, uncertain and fleeting, are too often the only results. The method which reason and experience both approve is reversed, and pupils are put to committing to memory matters which they are not prepared to understand."

ORIGIN OF LAND-OWNERSHIP.

By DANIEL E. WING.

IT has been asserted that nothing is so devoid of natural justice and moral right as private ownership in land—the sole dominion over a portion of the earth's surface which one man claims and exercises to the exclusion of the dominion of every other man therein. The proposition would be true, and private ownership in land would work the greatest injustice that the mind can conceive—human slavery absolute—if it were possible that one man or a set of men with one common motive could appropriate all land. But such a thing is absurd. And it is denied that private ownership in land as now constituted is unjust, or detrimental to the best interests of mankind associated in the social organization of the world.

Let us assume that primarily land was held in common, or a yet stronger proposition, that it is a law of nature that all land shall be so owned and enjoyed. By the same law of nature, and by reason, he who first began to use a particular spot or field acquired therein a kind of transient property that lasted so long as he was using it. The right to use it lasted so long as possession continued, and with death or removal, possession ceasing, the personal right of usage ceased also, and the land was open to the next occupant. That is, whoever was in occupation acquired for the time being a sort of ownership, a *quasi*-ownership for the purpose of subsistence, or rest if you please, and to drive him therefrom by force would be a violation of the same law of nature. But once he quitted it, another, having the same right of use and an equal claim to occupancy, might seize it without injustice. Applying this system to an imaginary or ideal state, to men having a common interest and few wants, and those supplied from nature by the simpler forms of industry, the result is a picture of comfort and competence for every one of the community; in fact, an extensive household, with its respected father or chief, around whom cluster the helpless and inexperienced.

But will any one say that no more stable way of holding land than this is required in a society teeming with population, where each man eager for gain is pressing, pushing, and jostling his neighbor—where the industry of one man may have added to the fertility and usefulness of his land what neglect and sloth have denied to that of another? Every man's hand would be raised against his neighbor, and there would be no domestic quietude or personal security; and, consequently, no social bond, civil government, or commercial life. This insecurity I apprehend to be the prime cause of establishing a more permanent property in land.

Necessity gave to the occupant more than a mere transient interest. Necessity gave a species of *property* in the soil, and, in order to insure that property, recourse was had to social organization, to laws, and punishments for violation of laws.

Now, when man enters into civil society and partakes of its benefits, he must surrender some of his absolute personal rights, or exchange them, as it were, for such relative rights as are incident to men as factors of society. This is no loss or hardship, for he gains by exchange that security of person and property which it is the object of civil government to insure; whereas, in the natural state, every other man being possessed of the same absolute rights of person and property, there would be no security either of person or property. The rights, then, belonging to a man in civil society, which we will call his civil rights, are the absolute right belonging to him by nature, so far restrained by civil law as is necessary and expedient for the general advantage of the community.

It being evidently natural that man should acquire a right of property in the soil, the next inquiry is, how property became actually vested. As occupancy gave the right to temporary use, so occupancy also gave the original right of property in the thing used. The same law of nature would suggest that the first occupant who had by his industry and thrift added to the utility of the soil—in fact, developed by labor the only value therein—should become the owner. The product of a man's labor, the work of his hands, is his. Whatever he removes out of the condition that nature has left it in, he has mixed his labor with and joined to it something that is his own, and thereby acquires a property in the thing itself. Necessity, arising from insecurity of person and property, being assigned as the first and primary reason for private ownership in land, the right of a man to the product of his labor may be cited as a secondary reason.

Although by theory of civil law as well as by usage, ripening into universal sanction, the ownership of land is deemed to be in private individuals, can it be said, after all, honestly and rationally, that the individual has an ownership of the soil as absolute as in the case of personal property? His interest is rather possessory for the time being, the manner of his enjoyment usufructuary: he can not move the land or carry it with him from place to place; he can not change the nature of it; he can merely draw from its substance for the time being, to the exclusion of all others from such use. In such exclusive use he is as much supported and upheld by natural justice and moral right as in the case of personal property. His labor and capital have improved it, beautified it, rendered it more productive, and enhanced its utility; and, so far as value is concerned, it will be argued hereafter that

land has no value except as labor has made one for it. So I suggest the possessory and usufructuary interest of the individual in land is not the absolute ownership and proprietorship of the soil.

Let us see if anything more than occupation, by successive individuals, is contemplated by social law, or by statute law in England or America. In England the proprietary ownership of all land is by common law in the people as represented by the king, the trustee under the social system of all their common interests, rights, and properties. In the United States it is vested directly in the people. By the Constitution and statute of New York State, "the people of the State in their right of sovereignty are deemed to possess the original and ultimate property in and to all lands within the jurisdiction of the State." This I understand to signify precisely what the common law of England and the universal law of nature are: namely, that all property in land was originally vested in the people in common; and if there ever happens a time when no person is in occupation of any portion thereof, the tenancy in common of the whole community immediately goes on again just the same as when, after the first occupant or squatter had relinquished his temporary occupancy, the whole community was again in possession, every man having the right to occupy it, but all in common. So I assert that private ownership, so called, is not a proprietary quality. It extends to and includes only the use; the absolute ownership of all land being, in fact, in the community composed of all individuals.

Suppose that every new-born offspring of that community by virtue of natural right becomes a tenant in common with all individuals then existing, should he share in the possessory right or use of a particular piece of land already in occupation of an individual? By being debarred from such possession, it may be that he is deprived of a natural right, but he becomes a member of the society into which he is born, governed by its laws for the time being, surrendering some portion of his natural and absolute rights for the protection guaranteed by the existing social laws, and participates in all the advantages now existing as well as in the advancement and social improvement of all previous time. Is he, then, defrauded?

The possession of land remains in the occupant by right and justice till such time as he does some act indicating his intention to abandon it, whereupon it becomes common property, and liable to be again appropriated by the next comer. Sale and delivery of possession to a purchaser are forms for the convenience of social government, and instituted with a view, I apprehend, of preserving the quiet and security of social order. By means thereof the present occupant indicates his intention to abandon the land appropriated. The deed of conveyance is an evidence of

that intention; and the purchaser, being the first acquainted with such intention, steps in and seizes the vacant possession. Thus the act of abandonment gives the new taker a right against the first, acting by what is known in law as an estoppel, and possession or occupancy is by natural law good against all the world besides. The most effectual way of abandonment is by death of the occupant, when both the possession and intention of keeping possession ceasing, the right of occupancy by natural law also ceases, and the land is open to the next taker. The custom, which has ripened into statute law, that the next of blood take on decease of the occupant, has its foundation in natural law instead of mere civil right. A man's children, those of his blood, his nearest relatives, are usually about him on his death-bed, and are presumably the first witnesses of his decease. They become, therefore, presumably and by natural law, the next occupants, until in process of time this frequent usage ripened into social law.

I have gone to this length in discussing the origin of so-called private property in land to ascertain on what support of natural justice and moral right it rests. This consideration is the foundation upon which stands the whole superstructure of proposed single taxation; for, "if private property in land be just, then is the remedy proposed a false one." If the individual has no such property, or the tenure by which he holds occupancy is supported by natural law, and his use of the land is consistent with natural justice, even though it works a wrong to another, the fault is not due to "maladministration of social laws," in this particular at least.

Investigation leads me to assert that the occupant of to-day holds by a tenure as much supported by natural justice and moral right as did the first taker; and more so, because he has, by exchange of his capital, the product of his labor, purchased the improvements added by every occupant preceding him.

Land has no absolute value. In a natural state and unoccupied by man it produces no wealth. It is only as capital and labor are applied to it that it becomes a factor in wealth, and hence acquires a commercial value. I agree to the proposition that what a man makes or produces is his own to enjoy, to use, to exchange, or to give; that no one else can rightfully claim it, and his exclusive right to it involves no wrong to any one else. So, if by his labor and capital man in occupation of land removes it from the state in which Nature has left it, improves it, renders it more productive, or if he acquires by exchange the improvements already made therein by another, he has joined to it something that is his own, and has created a value in it that did not exist before. Admitting the proposition that government, representing in the social state the common rights of the community, may

interfere and take the land occupied by such individual, as the whole community acting in common as owners might have ejected the first taker, yet on the principle of natural justice and moral right it can do so only upon reimbursing the occupant for all improvements to the land—that is, for all the product of labor expended upon it, including that which he has become possessed of by purchase. Since all the value in land is due to the employment of capital and labor, such reimbursement should equal the present commercial value of the land to the occupant (owner). Upon this naturally just and moral principle rests the constitutional restriction to eminent domain, that private property shall not be taken for public use without just compensation.

Nor can I see that, because land occupied by an individual may have a value beyond the value of the labor expended upon it, by reason of its proximity to other lands upon which greater wealth has been expended by other individuals, the injustice of deprivation is lessened. The same rule of reasoning applies to this unearned increment as applies to the actual labor value of the land. The present owner has acquired it by the exchange of his capital, which was the product of his labor elsewhere, and it is really as much a value made in the land by the expenditure of capital and labor as that represented by the actual labor of the first occupant. If so, it is included in the present commercial value of the land.

And why should land alone be deprived of this unearned increment? Other possessions receive a borrowed value from extraneous circumstances, such as the occurrence of war, change of fashion, etc., and no one suggests that it is not a true value to which the property or commodity is entitled.

To recapitulate:

By natural law land is owned by all men in common.

The first taker or occupant might rightfully appropriate so much to his exclusive use as a proper use thereof permitted.

His possession, to the exclusion of every one else, might continue so long as he used the land, or *while* he was using it.

Upon possession ceasing, his right to use it ceased, and the land was again held in common, subject to be again appropriated for use.

Insecurity in the use, since the occupant's labor added to the soil what before it was devoid of—a commercial value—necessitated a more substantial tenure, a sort of property in the soil which is called private ownership.

To secure this to individuals, social governments and social laws sprang into being.

These latter, either by common usage long established and acquiesced in, or by express provision, not only recognize but assert the law of nature in respect to property in land.

Sale of land in occupation of an individual is an act indicating his intention to abandon it, a grant or conveyance being the means established by social law to signify this intention.

The purchaser, being the first acquainted with such purpose, seizes the vacant land and is the next taker by natural law. The consideration paid represents the capital and labor expended in the land by all occupants, and the justice of such payment is sustained by every principle of natural law and moral right, since the capital and labor so expended represent all the commercial value that the land possesses.

And, finally, to deprive the individual of his occupancy and possession, although it be to reinstate the owners in common, can only be in natural justice and moral right upon payment of the value of the capital and labor represented in the land, which is the whole commercial value of the land.

It follows, then, that the demands of natural justice and moral right would be ignored if all taxes were put upon land, because one form only of labor and capital would be thus compelled to bear the whole burden of taxation.

THE GROSS AND NET GAIN OF RISING WAGES.

By ROBERT GIFFEN.

IN the discussions to which former papers of mine on working-class progress have given rise, there are some criticisms which have interested me very much. They are made by members of the working class themselves, who are slow enough to admit the average increase of their money earnings in the last fifty years which the figures demonstrate. But, admitting some increase of money, they go on to say, and admitting, too, the low prices, the improvement after all is not without drawbacks, or, as I have suggested in the above title, it is mainly in the gross. There are drawbacks which take away much of the apparent advantage. A general statement like this, apart from particular allegations to support it, could not but excite my attention, although I have avoided hitherto any discussion of it. It is a good rule to do one thing at a time. An improvement of money earnings and no increase of prices appeared to be two points worth establishing, whatever the drawbacks of a less apparent kind, and which the working classes could themselves best appreciate, might be. But while avoiding the discussion hitherto, I have been none the less observant, for the simple reason that each class knows its own grievances as no others can, and that such complaints, though easy enough to prove unfounded, are apt to cover facts which

will reward investigation—which will throw light, when properly understood, not only on the particular problems in hand, but on larger problems. I propose in the present paper to communicate some reflections which I have made. The alleged drawbacks, when considered, do, in fact, suggest for consideration questions of a weighty nature, which go to the root of ideas of progress, and affect the most general views of the prospects of modern civilization.

The alleged drawbacks of which I speak are mainly the following: First, it is said, workingmen in many cases have more to pay for rent than they would have to pay when earning less money under different conditions, or they have to pay railway or 'bus fares or similar charges for conveyance to and from their work, which are in the nature of an increase of rent. Consequently, although the money wage is more, the workman is not so much better off than he was, because a large part of that money wage has to be paid as a fine, practically, to enable the workingman to be in a position to earn it. In other words, the gross sum is more, but the net sum is not so much more. It is easy to perceive, also, that this principle may have a much wider application than may at first be surmised. The case usually thought of is that of rent, or an equivalent fine on a workman, which he pays in order to be in a certain place where the money wage can be earned. Suppose the climate in which he has to live in order to earn a larger money wage than he can get elsewhere is so exhausting as to compel a larger consumption of food in order that the money may be earned? The question of gross and net is thus of a wide-sweeping kind.

Next, it is maintained that along with a great increase in production, which has undoubtedly taken place, there has come an increase in the severity of the labor, and that the workman's remuneration has not risen in proportion. It seems to be suggested at times that the increase in the labor is itself an evil, even if it were proportionately remunerated, but the complaint rather is that the severer toil is not adequately compensated; the workman has a severer call made on his energies, and he is not so much better off. To be able to earn more money, it is sometimes urged, he must, in fact, spend more money on food and other things than he formerly did. Here, again, is a question of gross and net, and it will be observed how the last complaint raises in a different form the question already suggested under the first head by a consideration of the effects of climate. A distinction is made between the gross earning and the net surplus, the difference being something which the workingman has to pay as a fine to enable him to earn the net sum which he wishes to spend.

Last of all, it is maintained that on all sides the scale of living

has become more expensive. The workingman has to get more food, clothing, and shelter for his family than he would formerly have had to get; more is expected of him; and he has to pay for such things as the education of his children to a much greater extent than he would formerly have had to pay. In this way the strain upon the workingman has increased. As I understand the complaint, he is no more a free man than before. His energies are mortgaged in advance, and he has all the old difficulty to keep his footing in the world.

Now, whether these complaints are right or wrong, well or ill founded, it is clear that they involve problems of a most vital kind as to the general effect upon the working classes of the conditions of modern civilization. To take the first head of complaint. If it be the case that a rise of rent or the charge for traveling between the place of living and the place of work or similar expenditure is sufficient to deprive workingmen of the advantage of increased money wages, then the congregation of men in cities or in certain parts of cities, where higher money wages are to be obtained than elsewhere, which appear to be the conditions of modern industrial life, would be fatal to improvement. It would be the same with the necessity for working in an exhausting climate. The problem, as stated, is certainly of the gravest kind. The questions raised by the second head of complaint are just as important. If increase of toil, not proportionately remunerated—for which perhaps there can be no proportionate remuneration—comes with the increase of productive capacity and the greater call thus made on the nervous and mental energy of the workman, what is the workingman the better off for all the civilization? Finally, as regards the increased cost of living through a rise in the scale, may it not be the case that such a rise in the scale of living is to some extent what is meant by progress, though the drawback of the slavery of the workers, which some workingmen appear to feel so keenly, remains? How far is the "slavery" itself avoidable, so long as human nature is what it is, unless at the risk of all civilization perishing? Such problems are obviously of the deepest interest. The desire for leisure, for an ease to a severe strain, in all these complaints, is itself very striking, and may perhaps be held of itself to indicate a change of working-class conditions, as compared with a time when the masses simply endured, or were content to drag on a dull existence, with little color in it, and without hope of change. The whole subject, at any rate, should be well worth considering. What are the facts, and what should be the conclusions regarding them?

Dealing with the first head of complaint, which is perhaps the simplest and most easily dealt with, we must allow it to be obvi-

ous on the surface that there is a real point for discussion. Under the essential conditions of modern life, principally the concentration of huge masses on narrow room, competition among laborers undoubtedly produces monopoly rent, the payment of which is a simple deduction from the gross money wages which workmen receive. If workmen, to avoid paying more than they can help, live at a distance from their work, they only escape the evil partially, because charges for conveyance to and from their work have to be paid. Clearly workmen under such conditions, as compared with conditions under which no monopoly rent or its equivalent has to be paid, are at a disadvantage. To show their real position for the purpose of comparison, the monopoly portion of the rent must be deducted. It is quite obvious, also, on the merest superficial aspect of the question, that as regards many workmen, at least, the disadvantage may easily be so serious as to compensate, and more than compensate, all the difference between the money wage of the country, where there is no monopoly rent, and the money wage of the town. Take the case of a west Highland peasant fifty years ago, living on a scanty wage of a few shillings a week, or the produce of a poor croft eked out by kelp-gathering or fishing, and his descendant at the present time in the slums of a great city, earning perhaps fifteen shillings a week, but disbursing four or five shillings for rent. The improvement in money earnings may be immense, perhaps one hundred per cent, and as regards prices of commodities there may be no drawback in the change, but the rent takes a monstrous cantle out of the margin. Comparing all the conditions, it may certainly be doubted whether the peasant, in the case supposed, in exchanging the hard life of the country, which still had the advantage of being in the open, for the hard life of the city, has made any real advance. Take a case higher in the scale. A doctor, to earn a living, resides in a city rather than in the country, pays a huge monopoly rent to begin with, and incurs many other analogous expenses, so that altogether he has a large leeway to make up before he can reckon that net income which can properly enter into comparison with that of his country colleague. The difference may easily be so great, I believe, that in many cases a professional man in a small country town with three or four hundred pounds a year may have a larger net income for the real objects of life, dealing with the question in a wise, philosophic spirit, than a professional man in London with a thousand or twelve hundred pounds a year. There are differences even between London and smaller provincial cities. Thus the question between gross and net, which workingmen have raised in these discussions, apropos of monopoly rent or the equivalent, is a real question. It is a new form of the old theorem that people may buy gold too dear.

I have already, in part, dealt with the question practically as far as workingmen are concerned, by pointing out the really narrow limits of monopoly rent,* and practically the final conclusion must be reached by the statistical method, and in the way I have already used. But I wish to avoid statistics for the present, and to indicate merely the general conditions of the problem to be solved, which appear to minimize the possible extent of the alleged drawback.

It is clear, first of all, on general grounds, that the concentration of men in cities is due to the fact that cities, on the whole, weigh in the balance against the country. There is more and better employment there than in the country, all deductions made, in the opinion of those interested; and that seems a conclusive answer to the question as to whether, on the whole, there is not a net as well as a gross improvement in wages as far as this drawback is concerned.

Next, it is plain that, as a great part of the improvement of the last fifty years has consisted in the substitution of artisan and other highly paid labor for merely rude labor, the additional monopoly rent payable in the cities can only be, in most cases, a comparatively trifling drawback. It may be the case that, if we compare the former peasant of the country with the rude laborer of the city, and especially of the metropolis, the latter has hardly gained; but if we compare the former peasant of the country with the town artisan of the present time, although the latter has to pay monopoly rent or an equivalent charge for conveyance, there is still an enormous gain in the latter's position. It is the same with the professional classes. If the latter were stationary in number, or increasing only *pari passu* with the increase of population, then the larger gross income on the average earned by the masses of professional men in cities, as compared with the professional incomes earned in the country formerly, might show little *net* improvement; but allowance has to be made for the fact that the number of such incomes has enormously increased, and that the earners largely compare with the earners of wholly inferior incomes in former times, whether in town or country. As the increase of these classes could not have taken place without the growth of cities, there must be a large net as well as gross gain to be reckoned when the comparison is properly made.

To bring the matter to a point, what I have to urge is, that the very growth of cities implies the existence of conditions under which workmen of higher grades take the place of workmen of lower grades, so that, although class for class a workman passing from country to town does not seem to gain so very much, on account of the difference between gross and net, yet,

* See "Essays in Finance," second series, pp. 381, 382.

man for man, on the average there is an enormous gain. Illusion is produced because the proper terms of the comparison are lost sight of. The point is especially important as regards what is known as the residuum. Nothing can appear so deplorable or so hopeless as the conditions of the floating mass of rude labor in large cities. Monopoly rents in this case appear to sweep away all possible advantage which may result from higher money wage, comparing the laborer of the town with the laborer of the country. In many cases, even, it must be admitted, the "residuary" of the city is on a lower level than the "residuary" of the country. His "net" earnings are less. But the question, after all, is one of proportion. The absolute magnitude of the city residuum must not blind us to the fact that it may be, not an increasing but a diminishing element with reference to the population generally. I believe it is a diminishing element, but this would hardly be the place to discuss the point, and I am content for the present to call attention to its importance in the discussion. The assumption, so often made, that the residuum is increasing relatively, is one which requires proof, and I have never seen any attempt at proof, while there are some broad facts, such as the diminution of serious crime and of pauperism, against it.

The question of the way in which the net value of an increase of money wages may be affected by the necessity of living in a more exhausting, or in some way more expensive, climate, or by the specially exhausting character of a highly paid occupation, such as puddling, is one of the same kind. There is clearly a point in the matter for consideration and discussion. I am disposed to believe, for instance, that the exhausting climate of the United States, compelling the consumption of more food to enable the same work to be done, is a distinct drawback to the American workingman as compared with his competitor in western Europe, and especially in Great Britain. I am not sure but that living in the south of England, owing to climate, is more expensive than in the north and in Scotland. The point has hardly been expressly considered, the workingman practically having been right to go where he gets the highest money wage, but it is one that may become of increasing practical interest now that charges for conveyance are so low throughout the world as to make it quite unnecessary for men to live near the places where their food and raw materials are produced. I shall be well content for the present if the remarks here made induce some workingmen to elaborate it from their practical experiences. Of course, in any discussion it would also have to be considered that the greater expense of living may not be a pure drawback. The ability to consume and produce more, to bear exhausting climate or occupation, in fact, may be a good thing, and bring its own

compensation, although the net gain, taking matters strictly, may hardly be appreciable.

The next head of complaint is the increase in the severity of labor and the want of any proportionate remuneration.

On this head it may be admitted, to begin with, that there is apparent foundation for some of the complaints. Workmen in particular employments do not get a reward at all in proportion to the increase of production in those employments. The illustration of a cotton-mill is familiar. A single attendant on a number of machines will "produce" as much in an hour as formerly in a year or two, but his wages are only double—or perhaps not quite double—what they were when the production was so much less. A great steamship supplies another illustration. The ship does many times the work which could have been performed by the sailing ship it has displaced, and with much fewer men in proportion to the tonnage conveyed. But the wages of the average member of the crew are again only double, or not quite double, what they were when the conveyance done was so much less. In these and similar cases, who gets the benefit of all the increase of production? The workmen in the particular employments concerned, receiving only a fraction of the gain, may be excused for suspecting that there is something inexplicable in those social and economic arrangements by which the benefit is spirited away from them.

But, however natural the question, it is not difficult to point out that there is a good reason why workmen in some given employments should only receive a fraction of the benefit from the increased productiveness of those employments, and that this fact is quite consistent with an improvement in the position of workmen all round in proportion to the generally increased productiveness of labor, which is the real question we are now investigating, for the purpose of comparing this increase of productiveness with the increase of the severity of labor throughout society. The short explanation is that the employments in which there is a great increase of production, being mainly the employments in which there are great mechanical improvements from time to time, constitute only a part of the whole employment for labor, and that by a natural law labor in each employment finds its level, the increase of the return arising from an invention in a particular employment resulting in a gain, not to the particular laborers concerned, but to the whole community of laborers. That the gain may be general, it is, in fact, essential that laborers generally should gain as consumers rather than as producers, which implies that in a given employment wages should increase, not in proportion to the increased productiveness of that employ-

ment by itself, but in proportion to the increased productiveness of labor generally. Hence, it may well be that while the productive power of machines may enormously increase, yet the general increase of productive power may be much less than would at first be thought, owing to the comparatively small proportion of laborers, after all, who use machinery of great capacity largely in their employments. Looking at the number of domestic servants, of clerks, of professional men and women, of unskilled laborers of every kind, of skilled laborers, such as painters, who do not use machines, I should doubt very much whether one fourth of the laborers, even in a society like that of England, the most manufacturing in the world, use machinery of great capacity in their employments. It is easily to be accounted for, therefore, why in a given employment there should be a great increase of production without a corresponding increase of remuneration to those engaged in that particular employment. The gain has to be diffused through society, and the increase of production generally is not so great, and not nearly so great, as in a few special cases.

Another observation must be made. There may be a considerable improvement in the quality of production in employments of a non-mechanical kind, which it is difficult or even impossible to note by quantities, but where the labor competes with all other labor for remuneration. Where the increased remuneration should go to, when machines improve, is not thus so easy to determine *a priori*.

It is also obvious that even in an advancing community the remuneration of certain kinds of laborers, whose numbers continue disproportionate, may either not increase at all, or increase very little, the whole gain from increased productiveness being for the benefit of the laborers whose own labor improves in quality, apart from the fact that it is employed on more productive machines. Strictly speaking, unless there is a rise in the scale of living, accompanied by an improvement in quality all round, there is no reason why, in modern times, a man who can only drive a spade into the ground, or wheel a barrow, or carry bricks up a ladder, should receive any higher reward than similar laborers in former ages. The fact that such laborers are little better off is not inconsistent with the fact that workmen generally receive a larger reward than in any former period.

The way is thus cleared for answering the question as to whether the remuneration of labor has increased generally in proportion to the increased severity of labor.

It can not be denied, first of all, that there is a great increase of the productiveness of labor itself, as well as a great increase of the absolute amount of remuneration. This is admitted on all

sides. The increase of production is the very fact which is assumed. Nor is the increase of remuneration denied—the only question is of the proportionate remuneration. Before passing from this point, however, I should like to dwell a little on the fact already referred to, of an improvement in the quality of non-mechanical labor, because, as this labor is largely the subject of direct exchange without much intervention of capital, the mere fact of improvement implies almost a proportionate increase of remuneration. At any rate, the laborers concerned get almost the whole benefit, because they exchange with each other. I refer to such employments as those of teaching, medical attendance, nursing, domestic service, dressmaking, and the like among the upper and middle classes. The increase of remuneration here may not be in proportion to the improvement of quality; the game may not be worth the candle; but, at any rate, the exchanges are direct. Now, as to the fact of great improvement, I believe there is no doubt. Nursing, for instance, is said to be an entirely different thing in hospitals from what it was only fifteen or twenty years ago. Domestic service, as regards cooking, waiting, and other points, is also, on the whole, better, notwithstanding manifold complaints, just because of the general improvement in education and intelligence. The same with dressmaking. More intelligence and skill are everywhere applied, and in direct exchanges, without much intervention of machines or of capital.

Next, it has to be considered, as regards the question of proportionate remuneration, that by the very mode of here stating the question, it appears that it is not so much a question of increase in the severity of labor generally, as of a change in the character of the labor. If the quality of labor has altered and improved in many directions, there is, in truth, no proper term for comparison between the present and former times. The improvement of the quality of the labor, which is another name for the increased intelligence and energy of society, may not be proportionately remunerated; but there is no means of telling. People would not go back to the conditions of a former society, where less intelligence and energy were required for a lower scale of living, even if they had the choice. The new advantages, with all their drawbacks, are accepted as part of a higher state. The complaints are to some extent a sign of the perpetual unrest of human life, and of the fact of improvement itself.

There can equally be no doubt, looking at the matter in this way, that in certain directions there may be a very poignant and not unjustifiable feeling as to an increase in the severity of labor. This appears to be the case as regards employments which involve the watching of machines, the very employments where there is apparently the greatest increase of production and the

least proportionate increase of the remuneration of labor. The strain upon the nervous system, through the combined monotony of the employment and the constant vigilance required, are no doubt very often most severe, and are perhaps felt the more because the present generation is comparatively untrained. But the increased severity of toil, without proportionate remuneration, might be admitted in those special employments without altering the fact that remuneration has increased generally. What seems to have happened in these cases is, that the development of society imposes a heavy burden on a special class, involving rapid change in the quality of its labor, to which it is hardly equal, but that the improvement in quality is part of the general improvement in society. The nervous power to stand monotony and supply the necessary vigilance and other moral qualities necessary for the supervision of machines may exist in greater abundance in the next generation, along with a continued improvement in the quality of labor in non-mechanical employments.

It will, perhaps, be urged that the workman does not get a proportionate remuneration because the capitalist obtains for himself the increased product—the socialist argument. But the facts are all against this explanation. One of the most remarkable facts of recent years is the general decline in the return to capital. Capitalists from year to year have been willing to invest for a smaller and smaller return. We must assume, then, that if they have gained at all it has only been by the immense cheapening of commodities, and labor has gained more than in proportion. This would appear to be the case: only the laborers who have gained, as we have seen, are not specially those who are occupied about machines. The gain is generally diffused, and is received by laborers generally in proportion to the relative values of their work. Apparently the greatest gain has been among the higher artisan and lower professional classes—the very classes, it may be remarked, by whom the strain of modern life is felt the most intensely.

The conclusion, then, is, that if the return to labor generally is not proportionate to the increase of the severity of toil itself, the reason must be that people are working for inadequate objects. The game, in one sense, may not be worth the candle. The problem is another form of the very same problem that has been considered with reference to the payment of monopoly rents. On the whole, notwithstanding all the drawbacks of city life, there is some improvement which makes the payment of monopoly rents worth while. People would not change back to the former conditions. So, on the whole, notwithstanding all the drawbacks of really severer toil, and the inadequacy of the addi-

tional remuneration, people would not change back. What has happened is really a revolution in the quality of labor and the general conditions of life. The net gain, in one view, is less than the apparent gross improvement, looking at the matter strictly; in another view, the gain is so great as to make the present condition of workmen on the average incommensurable with their former condition. The two things are not on the same plane, and can hardly be compared.

An important corollary seems to be suggested by these considerations. If there is so much doubt about the adequacy of the reward for the additional labor thrown on workmen by the conditions of modern society, is not that reward really a minimum reward? In other words, may not the amount of production itself be conditioned by the energy of the workman, which is in turn a function of the food and other things on which he expends his wages, so that the quality of labor by which modern society is carried on would not itself exist if the remuneration were less than it is? The complaint we are dealing with is that of the severity of modern toil, and implies that the workman is tasked to his full capacity, and can just do the work, so that the remuneration can not be reduced. And that this is really the case in many employments may be easily enough illustrated. It is quite certain that the driver of an express engine could not go through the very formidable labors he undergoes if he only had the food of the rude laborer of a former time, and only lived in the way that such a laborer used to live. He would not, under such conditions, have the energy or brain-power for the work to be done. It is the same with workmen in a factory who have to attend to many machines. The constant strain simply could not be endured if the workman had to live as the factory worker of a former time had to live. The present worker is really cheaper than the former worker, because he does more in proportion; but, dear as he is, yet, in another respect, he may perhaps be viewed, according to a suggestion already made, as really engaged at a minimum wage—without which he could not do the work at all. This is not a question merely of a rise in the scale of living, though that question is intermixed with it. It is a question of the actual necessity on the part of the workman that certain things should be put into him, or supplied to him, as a condition of his doing the work which he actually performs. What is true of the workman specially referred to is of course still more true of the higher kinds of work involving artistic or other skill.

It may also be added that the suggestion already made as to the reason for a non-increase of remuneration in certain directions being that the work done has not itself improved in quality, is fully confirmed by the general view thus stated. If the work

which has improved in quality is itself only so remunerated as to make it doubtful whether the remuneration is adequate, whether the game is worth the candle, and is, in fact, at the point of minimum, so as to enable the work to be done at all, out of what fund is the remuneration of the work that has not improved in quality to come? In the midst of plenty, apparently, such workmen, by comparison, must starve, because, notwithstanding all the plenty, those who really do the hard work of modern society are only just paid, and no more. It is easy for such workmen and their so-called friends to point to the capitalists as living on *their* labor; and no doubt, if it were possible to divide the earnings of capitalists among society generally, according to numbers, these particular workmen might be much better off. But it is not from the labor of such workmen that capitalists mainly derive their income, while those who do work, as we have seen, have so large a remuneration that they can have no quarrel with the capitalist. The suggested division would therefore only be for the benefit of a special class whose existence is itself a danger to society, and which should rather be discouraged than encouraged, the whole efforts of society being rather directed to their transformation by education and similar agencies into a higher class, than to securing an increased payment for their work under present conditions. The curse of the very poor, in more senses than one, is their poverty—poverty in strength, in mental capacity, in moral qualities. They are poor because they can not earn more. If they were stronger they would have the earnings, and would have no quarrel with the capitalists. To improve their condition they must be made stronger, and not merely given more to spend, which would be a curse to them instead of a blessing, as it is to the merely idle capitalist whose luxury they envy, whose existence is a danger to society also, and whose obliteration, or rather transformation into a different class, is equally to be sought for.

The next head of complaint is that a workman has more expenses now, in consequence of the rise in the scale of living. Not only himself, but his family, must live better. They must have better and more food, be better clothed and sheltered, be better educated, and so on. The workman himself, on whom the burden falls, has no more surplus than before. He is not a freer man.

This head of complaint, however, demands very little remark. The statement of the complaint is, in truth, one of the best evidences of progress. Of course, there has been a rise in the scale of living. Such a rise was quite certain to come with an improvement in the earnings of workmen. The fact that it has come is itself one of the proofs of improvement. No doubt there is a continued absence of a free surplus. I suspect, however, that at no time have many people, in this country at least, had philosophy

enough to be thrifty and careful, and to do without some things that appear to be necessary for their sphere in life, so as to have what is meant by a surplus. Its absence is certainly no proof that the condition of those who make the complaint has not improved. The scale of living has risen, and this rise, beyond all question, imposes a strain upon many workmen which only the greatest care and philosophy can mitigate. It involves of necessity severer toil on the part of the bread-winner, with no apparent surplus for himself.

It is apparent, however, that to some extent what is called a rise in the scale of living is, in reality, an improvement in the mode of living which is absolutely necessitated by the work itself, without which, in fact, the work could not be done. Where moral qualities are to be displayed, and great vigor, punctuality, and energy are required, they are not to be expected except from workmen of a certain class, whose scale of living has, in fact, risen to the standard necessary, and whose "medium" and "atmosphere," of which the condition of wife and children or relations is a part, are altogether different from what they were. Before human beings can display the qualities and exert the energies required, they must have certain tastes and wants to gratify, or there would be no motive to exhibit those qualities and energies. Hence a rise in the scale of living is only another mode of describing the improvement in the character of the workman, which is essential to the performance of the work to be done.

The conclusions of this long argument may now be very shortly restated. In certain cases the increase of net earnings by the advance of the last fifty years can not be so great as the increase of gross earnings, because some classes of workmen have to submit to an increased charge for rent and railway fares, and similar expenditure, which really amount to a reduction from the gross earnings which they receive. But, on the whole, the classes of workmen affected in this way must, from the nature of things, be comparatively small, while the general conditions are such that the deduction from gross earnings, as a rule, still leaves an enormous net gain. Next, the allegation as to the increased severity of labor, and as to workmen not getting a sufficiently adequate remuneration or a sufficient share of the increased gross produce, is met by the admission generally of an increase in the severity of labor, which, however, is found to be more properly described as a revolution in the quality of the labor, and to be connected with the fact of improvement generally, and to be evidence of improvement in the workman's condition. The character of labor generally has so changed that it can not really be measured in comparison with the labor of a former time. Some work-

men engaged about machines may appear to get comparatively little of the increased production for themselves, but the reason is that the improvement in machines is for the benefit of society as a whole, and not specially for that of the particular workmen engaged upon them, who only participate in the improvement as consumers, and not as producers. Substantially, however, there is more severe toil all round, and whether the additional remuneration is adequate or not, the change in the quality of the labor is necessary to the production, the laborer gets all the possible remuneration, and the labor itself could not be carried on without the remuneration obtained. It is the same with the complaint as to the rise in the scale of living. The rise in the scale is at once a proof of the improvement in the workman's condition, and of the necessity for an improvement in his living to enable him to do the new work. The two things are inextricably connected. On the whole, the complaint of workmen as to the difference between gross and net is not unjustified, but it points to changes in their condition of a remarkable kind, which are in every way deserving of further study. To show fully what these changes are, statistics would be needed, but the necessary conditions of the problem are apparent without statistics. The complaints here dealt with could not exist without that improvement in society and the condition of the masses which the complaints seem to call in question.

A further conclusion may be drawn. The conditions of life thus indicated seem favorable, on the whole, to a continuous improvement in society, so long as science and art make progress, and heavier and heavier calls are made on the intelligence and energy of workmen, along with an increase of their capacities on the one side and their wants on the other. The whole structure of modern society is such as to require greater and greater knowledge, greater and greater energy and moral power, greater and greater capacity of every kind, so as to make sure that machines and inventions are maintained and improved, and that artistic capacities and the arts of living are developed to correspond. The continuous improvement implies a continuous improvement, on the average, of the human being who really belongs to the new society. So long as society, therefore, continues to progress—that is, for our present purpose, so long as the average workman continues to produce more quantity or better quality—there must be continuous improvement and progress in the quality of workmen themselves and the conditions of their existence, although we should not expect that complaints would cease as to the greater severity of toil and as to particular classes of workmen not getting for themselves the full benefit of the increased production. Still, the improvement is there, and the complaints, when analyzed, are, in truth, signs of the improvement.

The one doubtful sign, it appears to me, as regards the future, is pointed at by the qualification implied in the words—the human being *who really belongs to the new society*. It may possibly happen that there will be an increase, or at least non-diminution, of what may be called the social wreckage. A class may continue to exist and even increase in the midst of our civilization, possibly not a large class in proportion, but still a considerable class, who are out of the improvement altogether, who are capable of nothing but the rudest labor, and who have neither the moral nor the mental qualities fitted for the strain of the work of modern society. On the other side, as already hinted, the existence of what may be called a barbarian class among the capitalist classes, living in idle luxury and not bearing the burden of society in any way, seems also a danger. But speculations of this sort would perhaps take us too far at present. Substantially, as yet, there seems to be no reason to doubt the steadiness of the improvement in recent years among the working classes, both those practically so called and those who may be included when we use the language in its widest—that is, the strictly economic—sense, and that this improvement goes on from year to year, and from generation to generation, and must, in the nature of things, go on, in consequence of the improvements and inventions of the modern world and the general spread of education, so long as nothing happens to prevent a continuous improvement in the efficiency of human labor and the average return it can obtain from the forces with which it works.—*Contemporary Review.*

CONCERNING SHREWS.

By FREDERIK A. FERNALD.

THE shrews, or shrew mice, as they are often called from their mouse-like size and general appearance, are nearly related to the moles, but may be distinguished from them by their distinct outer ear and the moderate size of their fore-paws, which are not usually employed in digging. They have a long, pointed muzzle, with two very long cutting teeth in each jaw—the upper much curved and the lower nearly horizontal. Their other teeth are many-pointed, being thus adapted to seizing the worms and crushing the hard wing-cases of the beetles which form their food. They also sometimes destroy small vertebrates and devour each other. Most species of shrews live on the surface of the ground, and a few in burrows. They do not hibernate. They take their food at night. They are spread over the northern hemisphere, sometimes going very far north, and the smaller spe-

cies enduring severe cold. The sub-family *Soricina* is the only one represented in North America; other sub-families are found in Europe, Asia, the East Indies, and in south and central Africa; none as yet have been detected in South America. Most of the American species belong to the genus *Sorex* (Linnæus). Prof. Spencer F. Baird described twelve species, varying in length from three to four and a half inches, in Vol. VIII of the Pacific Railroad Reports. In color they range from blackish and brownish to grayish above and lighter to whitish beneath. Most of the species belong on the Pacific coast or in the Northwestern States and Territories. The *S. personatus* is the least of the American shrews, and among the smallest of the quadrupeds of this country, being not quite three inches long; it belongs in the South Atlantic States. In the genus *Blarina* (Gray) the body is stout, the tail shorter than the head; the skull is short and broad, and the fore-paws are large in proportion to the hind-paws. This genus is peculiar to America. The mole shrew (*B. talpoides*, Gray), the largest of the American shrews, four and a half inches long, is found from Nova Scotia to Lake Superior, and southward to Georgia. It is dark, ashy gray above and paler below, with whitish feet. Several other species are described by Baird, of which two are in Mexico and Texas.

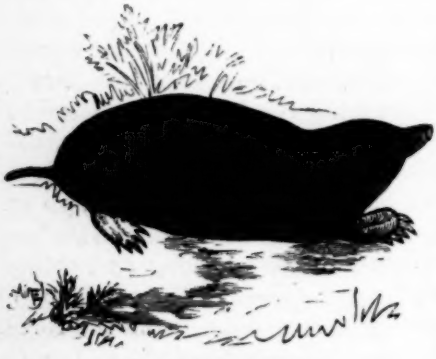

FIG. 1.—MOLE SHREW.

Four species of shrew are mentioned by Wood as inhabiting the British Isles: the erd shrew, the water shrew, the oared shrew, and the rustic shrew. The erd shrew, also called the shrew mouse, is the common shrew of England, and is found also all over Europe. Unlike most animals, they are often found dead; though, owing to their nocturnal habits, they are seldom seen alive. Aubyn Battye writes in "Longman's Magazine": "Every countryman is familiar with the sight of shrew mice lying dead on autumn footpaths and by sides of roads. The hot, dry English September weather presses very hardly on this class of animals. Worms retire then a long way below ground, and even the strong mole often can not follow them in the hard-baked ground, and has to trust to slugs for maintenance. The damp, dead leaves of the hedge-bottom, which were once the shrew's best hunting-ground, are dry and deserted now—a fatal change of things. Yes, dead we often see the shrew; and picking him up we hold in

our hand a little creature of an oddly quaint and old-world appearance, with a coat like velvet, brownish black above and grayish white beneath. But the two ends of him strike us most; a long, pink-tipped snout, and a blunt, four-sided tail." Shrews are accustomed to eating much and often, which doubtless accounts for their dying so speedily when food becomes scarce. The reason why their bodies are seen lying about instead of being devoured by flesh-eating creatures is probably because they secrete a strong scent that does not seem to please the palate of cat or weasel. Cats will catch them to play with, and finally kill them, but will not eat them. Owls eat them, however, and so does the kestrel falcon. On account of this scent, the animal is known in some parts of England by the name of fetid shrew. In Scotland it is called the ranny. The Latin term *araneus*, or spider-like, has been applied to this creature by several writers, because it was said to bite poisonously like a spider. The body of the shrew is not much over two inches long, and its whole length from the snout to the tip of the tail is about four inches. It lives in little tunnels which it digs in the earth, and which serve also as a hunting-ground. The nest in which the young shrews are brought forth is not made in the burrow, but in some little hollow or a hole in a bank. It is composed of leaves and like substances and is entered by a hole at the side. The young are from five to seven in number, and are generally born in the spring.

FIG. 2.—COMMON EUROPEAN SHREW (*Sorex araneus*).

The word shrew applied to a scolding woman has a different derivation, according to the dictionaries, from the name of our little insect-hunter. But it is no libel on the animal to give its name to a vixen even of a more unconquerable sort than is represented in Shakespeare's "Taming of the Shrew," as the following character which Wood gives it abundantly shows:

"Sometimes the shrews mutually kill each other, for they are most pugnacious little beings, and on small ground of quarrel enter into persevering and deadly combats; which, if they took place between larger animals, would be terrifically grand, but in such little creatures appear almost ludicrous. They hold with their rows of bristling teeth with the pertinacity of bull-dogs, and, heedless of everything but the paroxysm of their blind fury, roll

over each other on the ground, locked in spiteful embrace and uttering a rapid succession of shrill cries, which pierce the ears like needles of sound. It is a most fortunate circumstance that the larger animals are not so vindictively pugnacious as the moles and the shrews; for it would be a very hard case if we were unable to put two horses or two cows in the same field without the certainty of immediate fight, and the probability that one of the combatants would lose its life in the struggle."

The bite of such a little creature obviously need not be feared by a human being, though ancient prejudice attributes to it such venomous properties that in many districts in England the viper is no more dreaded than the shrew. Even the touch of the animal's tiny foot was believed to cause pains which could only be relieved on the "like cures like" principle.

The following curious account of this latter superstition is from Gilbert White's "Natural History of Selborne": "At the fourth corner of the Plestor, or area, near the church, there stood about twenty years ago a very old, grotesque, hollow pollard ash, which for ages had been looked on with no small veneration as a shrew ash. Now a shrew ash is an ash whose twigs or branches, when gently applied to the limbs of cattle, will immediately relieve the pains which a beast suffers from the running of a shrew mouse over the part affected; for it is supposed that a shrew mouse is of so baneful and deleterious a nature that wherever it creeps over a beast, be it horse, cow, or sheep, the suffering animal is afflicted with cruel anguish, and threatened with the loss of the use of the limb. Against this accident, to which they were continually liable, our provident forefathers always kept a shrew ash at hand, which, when once medicated, would maintain its virtue forever. A shrew ash was made thus: Into the body of the tree a deep hole was bored with an auger, and a poor devoted shrew mouse was thrust in alive and plugged in, no doubt with several quaint incantations long since forgotten."

The shrew is often seen near reposing cattle, and this habit probably gave the chance for putting upon it any unexplained malady that the cattle might suffer. But it has been well suggested that the shrew goes to domestic animals for the insects which light upon them. From the fact that the shrew will eat one of its own species, if slain in battle, it is evident that insects and worms do not form its whole diet. "One of these little creatures," says Wood, "has been discovered and killed while grasping a frog by the hind-leg; and so firmly did it maintain its grasp, that even after its death the sharp teeth still clung to the limb of the frog. Whether the creature intended to eat the frog, or whether it was urged to this act by revenge or other motive, is uncertain."

The water shrew is much like the erd shrew in general appearance, but its fur is nearly black on the upper parts of the body, instead of the reddish-brown color which marks its relative. On the under parts its fur is beautifully white. The fur is very silky and has the useful property of repelling water. When swimming, the parts of the body which are submerged appear to be sprinkled with tiny silver beads, which give the animal a very brilliant appearance. This phenomenon is due to air-bubbles that cling to the fur. Water shrews are fond of pools and streams that are pretty well open to the sunlight.

The following account of them is given by the writer in "Longman's," already quoted: "See these water shrews, how they chase one another in the pool! Out of the water their fur is black and soft, but under it a thousand air-bubbles clothe them round till they flash like silver fishes in the sun. In and out of the weeds they swim, picking off the fresh-water shrimps from under the leaves. No sea otter is more at home under the water than they. Yet are their feet not webbed, but only fringed about with stiff white hairs. Instead of swimming with the direct motion of the water rat, the water shrew appears to move alternately both its feet on either side. Unlike the common shrew, which rears its young near the surface of the ground, often in the old nest of a field mouse, the water shrew nests in holes under the bank. It generally, I think always, appropriates some existing hole, which it no doubt improves to its liking."

Fig. 3.—Water Shrew (*Crossopus fodiens*).

Besides catching aquatic insects, the water shrew roots out larvæ from the muddy banks with its long snout, and does not hesitate to eat moths and other like insects which fall into the water and drown. The ears of this creature are peculiarly adapted to prevent the entrance of water. When it goes beneath the surface, the pressure of the water folds together three small valves, which effectually close the opening of the ear. "The total length of the water shrew is not quite four inches and a half, the length

of the head and body being a little more than three inches, and that of the tail being about two inches. Its snout, although long, is not quite so narrow and pointed as that of the erd shrew, and its ears are remarkably small. When it swims, it has a curious habit of spreading out its sides, so as to flatten its body as it floats upon the water" (Wood).

Another kind of shrew which frequents the water is the oared shrew, so called from the oar-like shape of the feet and tail. It is the largest of the British shrews, its total length to the tip of the tail being about five inches and a quarter. The fur on its back is sprinkled with white hairs, and that on the flanks and belly is blackish gray, tinged with yellow. On account of the general dark appearance of its fur, it is sometimes called the "black water shrew." The rustic shrew (*Corsira rustica*) is found in many parts of England, while in Ireland it replaces the erd shrew.

The smallest mammal known to exist is found among the shrews. This is the Etruscan shrew, and it is found in Italy. Its head and body measure only an inch and a half in length, and its tail adds about an inch more.

A CHEMICAL PROLOGUE.

By C. HANFORD HENDERSON,

PROFESSOR OF PHYSICS AND CHEMISTRY IN THE PHILADELPHIA MANUAL TRAINING SCHOOL.

THE human infant, during the first few weeks of its life, must be regarded simply as a bundle of possibilities. A bright light, a loud noise, an appreciable degree of heat or of cold, produce, it is true, corresponding reactions. The child blinks, or it starts, or it shrinks, and there is manifest to the most careless observer a general sense of uneasiness. But these reactions must be regarded as purely involuntary. One can not discover in any of them the presence of thought. There is no co-ordination of the faculties. The touch includes anything that may come within reach. It does not act in any way in harmony with the eye. Nor does the gaze become fixed upon any object. The eye wanders from one thing to another without really seeing anything. Similarly with the sense of hearing. Sound is a mere vibration, without any meaning whatever. If it be sufficiently loud, it makes the infant start much as a violent explosion would shake a window or rattle a pile of dishes.

But as the weeks roll by, there comes a marked change. When the child reaches the age of three months the presence of will becomes unmistakable. The faculties begin to act in harmony with

each other; or, as we are apt to say, the child begins to take notice. Then it is that the birth of the human soul into the little body becomes apparent. The child is observed to fix its gaze upon objects. It begins to recognize faces; it begins to see; it begins to hear; it begins to feel. In a word, intelligence has dawned.

The years succeeding infancy are full of incident. Each day is crowded with new experiences and new sensations. Years pass before the most obvious of these are exhausted of their interest. The child reaches out its hand for the moon; it finds delight in the glancing sunbeam; it is surprised by its own reflection in the glass; it is charmed by all forms of rapid motion; it dances gleefully before the fire; it is made curious by the rustling of a leaf. The little man is full of the spirit of investigation. He is a true experimenter. He is constantly putting questions to Nature, and, after a fashion, he is finding answers. He awakens to consciousness in a world that is for him full of wonders and surprises. There is no truer fairy-land than that in which he daily moves. The ever-present mystery; the delightful sense of anticipation; the persistent belief in the impossible, make childhood—in spite of its little worries and absurd fears—a veritable paradise, from which advancing years, like the angel with the flaming sword, casts us out all too soon.

The activity of the child is exceedingly interesting in the abstract; perhaps a little inconvenient in the concrete. He throws a goblet on the floor, and is as much amazed that it should break as the owner of the goblet is annoyed. It is a destructive age, and is apt to meet with but little sympathy from older persons who forget that they have gained their own store of knowledge from just such a series of adventures. Children willingly sacrifice a toy to learn what it is made of, and I am disposed to think that the knowledge so gained is worth more than the plaything. And so the first years of life are spent in becoming acquainted with surrounding objects. The days are very full of pleasure when one is acquiring knowledge in this simple and natural fashion. All of us have gone through these experiences. By hundreds of tests—pleasant and otherwise—we have learned that certain substances are brittle or tough; are hard or soft; are rigid or flexible; are light or heavy. By repeated falls we have gained some notion of gravitation—that bodies unsupported will fall to the ground. Burned fingers have taught us that flame and fire are hot. Torn jackets have shown us that there is a point beyond which we can not go and expect cloth to resist strains. It is in this way that we have gained our stock of common knowledge. Experience *is* undoubtedly the best teacher. When maturity is reached, all have gained the greater part of this common stock, and the

affairs of everyday life proceed upon the very reasonable supposition that such knowledge may be taken for granted. But the question arises as to whether experience shall be permitted to end here, and so superficial a knowledge content us. It has been good for man to learn these more common truths. Would it not, then, be well for him to carry the search somewhat further, and to learn facts less commonly observed, as well as to investigate as far as he is able the cause and significance of all phenomena? There is but one answer: it is overwhelmingly affirmative.

It is to this problem that science addresses itself. The value of a study so intimately connected with the conduct of life is attracting an increasing number of students. The old battle between science and the classics in college curriculum does not need to be waged over again. Generations devoted to the pursuit of language have at length evolved a people in whom facility of expression is hereditary. The lack of something to say alone prevents universal authorship. The youth of the present day ask a discipline more inspiring than that offered by grammar and lexicon. It is found that the mind can be both instructed and trained without first killing the natural curiosity and interest of the pupil. It is true that there is a college near Philadelphia where a young woman is not even permitted to take a special course in biology unless she has an intimate knowledge of at least three foreign tongues, but happily such absurdities are rare. As a rule, the colleges and universities of the country have responded generously to the demand for broad scientific culture. In that field the battle has been won. But a little leaven leaveneth the whole. Beginning at the top of our educational system, the tendency toward scientific study is gradually making its way down to the very Kindergarten. It would be still more general, and would be a larger factor in individual life, were that important truth realized which Mr. Herbert Spencer has so often insisted upon, that scientific knowledge is simply a higher development of common knowledge, and means only more accurate and more extended thinking about our environment. And so, in science, we are to become again as little children, and put more questions to our great mother, Nature.

The results of this renewed questioning will not be trivial. They serve a dual purpose. They bring a much enlarged experience, and discover to us the relation between widely different phenomena. By the one service, the confines of our apprehended universe are expanded to such magnitudes that they demand for their occupancy the highest intellectual effort of which man is capable. Through the other, no confusion results from this immensity. It is a world of harmonies and relations. Man feels himself not oppressed, but inspired, by such a contemplation of

Infinity. He is one both with that star-beam which left its home before America was discovered, and with the blowing flower which a breath of summer has called forth. It is no mean vantage-ground, nor one which the spectacled haunter of libraries can afford to despise, to feel one's self a sharer in the pulsating life of the universe, to be a citizen of space, at home everywhere. Such is the position of the earnest scientist. He is the true poet and the true prophet. He lives in communion with a God who is the same yesterday, to-day, and forever; in whom there is no variableness, neither shadow of turning. This absolute confidence in the inexorableness of divine law begets a serenity of life which is with difficulty disturbed, and a deep morality of thought and deed which is seldom the child of more local revelation. The idea of chance or caprice becomes impossible.

"All's love, but all's law."

It is with a curious pity that the student of Nature watches the crowd of worshipers at the Tower of Babel. He is willing to admit, with Max Müller, that there is no thought without language, and no language without thought; but so pre-eminent seems the thought to him that he feels well assured that a suitable vehicle will not be wanting for the carriage of so royal a guest. To such a one, the conduct of life becomes the chief end of education. The crucial test which he applies to each branch of study offered to either young or old is not whether it is useful, but whether it is the *most* useful. He will not be satisfied with any choice that is merely second best, for time meanwhile is flying, and, if we do *this*, we can not do *that*. The question is not whether any particular course will bring wealth of information, but rather whether it will induce fullness of living. It is surprising with what a small stock of facts, if they be of the right sort, a man can get along, and still be happy and progressive. I remember, as a boy, the envious regard which I bestowed upon a little friend of mine, whose dexterity in the difficult art of parsing quite surpassed my own feebler efforts. But one day I made the discovery that not only was he no better for entertaining that sort of knowledge, but, what was more surprising, his English was no more polished than my own. Since that time I have had frequent occasion to recall the discovery, and I confess that it has reconciled me to an ignorance upon many similar subjects. The substitution of this artificial, lifeless knowledge for that which is natural and organic, must be regarded as scarcely less than criminal by those who hold the true aim of culture to be the evolution of wisdom and of goodness. A man can not be expected to think soundly about a world of which he is quite ignorant, or to bring himself into relation with a universe whose confines are nearer than his finger-ends.

It is true that scientific education may fail quite as dismally as the classical has in times past if the grand generalizations of science are to be obscured by its manifold details. Emerson has somewhere said, "Men are so prone to mistake the means for the end that even natural history has its pedants who mistake classification for science." As a detached fact, the knowledge that water is composed of hydrogen and oxygen has no value. It is only when brought into relation with other chemical facts that it becomes significant. The statement found in elementary physical geographies and geologies that nine hundred and seventy-seven thousandths of the earth's crust consist of the nine elements—oxygen, silicon, aluminium, calcium, magnesium, sodium, potassium, iron, and carbon—carries very little instruction with it unless the children know the substances of which these names are the symbols. Mere classification is a weariness of the flesh. Science has no greater lesson to teach than roots and case endings have, unless it be linked to human life. Nor must it be pursued externally; it must touch our own experience, and its truths become a part of us, to be remembered because they can not be forgotten. This is knowledge, and nothing less than this deserves the name.

It is not so difficult to make even the more profound scientific studies touch intimately our daily life as one would imagine who has been taught to mistake classification for science. It is true that the multitude of objects which come within the field of scientific research require for their distinction a nomenclature which is not brief, but the student needs only a small part of it in the beginning. His vocabulary will grow with the using. In his "American Addresses" Prof. Huxley says, "For the purpose of getting a definite knowledge of what constitutes the leading modifications of animal and plant life, it is not needful to examine more than a comparatively small number of animals and plants." This, indeed, is the distinctive method of science. The student is made to advance from the particular to the general. The result justifies the method. By knowing a few things well, one knows everything, for one can not know even a few things well without having discovered by that very study the essential unity underlying all things. Our great geologists are not those who have "done" the earth, but rather those who have patiently and persistently studied a very small corner of it. To this rational mode of study all sciences are unmistakably coming. From its very nature, chemistry has been among the last to fall into line. It has been held, and in most quarters is still held, that the number of substances studied by the chemist should be limited only by the span of life. In accordance with this view, the young student, instead of being allowed to make friends with a few of the

elements and really inquire into their secrets, has been hurriedly introduced to all of those available, and has been left to struggle as best he could with their multitudinous compounds. The result has been to confuse, and in many cases finally to disgust. Chemistry—and I do not wonder at it—has been voted "dry" by the majority of college boys.

This result has come about because the science has been unscientific. The meaning of science is *to know*, but one knows very little from such a gallop among the varied forms of matter. If one knows thoroughly two or three typical gases, two or three typical liquids, and two or three typical solids, he knows chemistry. He may not be worth much as a reference-book; but then encyclopædias are nearly always available, while thoughtful men are rare. Further, the quality of such knowledge deserves attention. It has become a part of the man himself, for he has learned it the way children learn things. It is no longer simply a fact of chemistry; it is a fact of life, a part of the oft-repeated experiences which go to make up his intelligence. Imagine for a moment the amusement of a bright boy were he asked whether he *remembered* if stones are hard, or lead heavy, or glass brittle. His answer will be that of course he does not; he *knows* that they are. It is knowledge of a similar definiteness that the scientific method strives to cultivate. Studied in this way, chemistry ceases to be a matter of simple memory, and becomes almost exclusively a branch of pure reasoning. It passes from the objective to the subjective world, and becomes a valuable means of mental development as well as a study now well worth pursuing for its own sake.

One of the first requisites, then, in the proper presentation of chemistry seems to be the entire banishment of that alien element which makes it a thing by itself, and the insistence upon its recognition as a purely natural extension of common knowledge. Any experience in life will form a suitable starting-point. It may readily be analyzed into its components; the chemical element can not well be missed. If the occurrence be such as we commonly call accidental, or, more strictly speaking, if it be devoid of human agency, it will resolve itself into two terms, conveniently expressible by the words matter and motion. If the occurrence be voluntarily producible, a third element is involved—that of will. It would be foreign to the present purpose to enter the vexed discussion of whether this third element, this unknown something which makes the distinction between conscious and unconscious existence, is the cause or the result of those reactions in matter and force with which will, as we know it, seems to be indissolubly connected. It will be sufficient for the present to call it x, a designation involving neither issues nor compromises.

Any common event, then, which may be selected by way of illustration, will furnish two elements open to scientific study—matter and motion. The distinction between the two is more convenient than essential, for we are unacquainted with matter devoid of motion, and the idea of motion divorced from matter is similarly unthinkable. However, the distinction is convenient, so that it will be well to follow it. The study of the analysis and synthesis of matter is the field of chemistry. The study of those varied motions which give to matter its apparent properties belongs to the domain of physics. The two sciences are commonly made the objects of separate study. It would be more true to nature to consider chemistry simply as a branch or subdivision of physics, for it is impossible to make any change in the constitution of matter without at the same time disturbing the physical equilibrium. Heat is either given out during the reaction or it is taken in. If it be chemical combination, heat is commonly disengaged; if a chemical disunion, heat is commonly involved. So general is the truth of this statement that we are able to predict what will occur chemically if the physical conditions are known. If there be two or more reactions possible, that one will take place which will liberate the greatest amount of heat. It is, indeed, the distinctive character of the so-called New Chemistry that it takes cognizance of the physical reaction which invariably accompanies the chemical. If the labors of Crookes, Roscoe, Hunt, and other eminent contemporary chemists count for anything, it is from such joint study as this that the best secrets of chemistry are to be evolved. With the view of lessening difficulties, this necessary interdependence between the chemical and physical is frequently omitted in presenting the science to young students; but the practice of teaching errors or half-truths, in order that the truth itself may afterward be apprehended, has as little excuse in science as it has in religion, for generally it is the error which proves obdurate, and the subsequent truth has no chance whatever. It robs the science, moreover, of an element of vitality which is one of its chief attractions.

In selecting our illustrations of chemical action, the more commonplace the event the better. The affairs of every-day life present such excellent objects for study that it would be as unnecessary as it would be uselessly distracting to go in search of the unusual, until the fundamental principles have been learned from a study of that which is familiar. That coal will burn, that milk will sour, that iron will rust, that cider will turn into vinegar, and that wood will decay, are all well-known facts of every-day life. But they are also facts of chemistry, for they involve a change in the composition of matter. It needs no scientist to perceive that the original coal, milk, iron, cider, and wood have

disappeared as such, and that new substances with totally different properties have taken their place. Yet this is all that a chemical reaction means. It may be studied any day in the kitchen. The question of heat is quite as obvious. The coal has been burned for that very purpose. At first sight these several facts seem entirely unrelated. They have been selected quite at random. A moment's consideration, however, will show that these reactions, though seemingly dissimilar, are essentially identical. Your cook may not be able to explain them to you, but she can tell how they may be prevented, and that will serve the purpose equally well. Her answer will be the same for all: Keep the air from them. A fire with all the draught closed off goes out. Hermetically sealed milk keeps fresh. Painted iron does not rust. Bottled cider remains cider. Wood, not exposed to the air, will endure for centuries. So, after all, the common element in these reactions is not difficult to find. It is manifestly the air, for, in the absence of that, they do not occur. To the chemist they are all cases of oxidation. If he wishes to prevent them, he does just what the cook does—he keeps the oxygen of the air away from them. That is all that Mr. Edison does when he pumps the air out of the bulb of his incandescent electric light, so that the little carbon horseshoe shall not burn up.

Now, there is nothing occult about all this. The examples given are not sufficient in number to warrant any very broad generalization, but they can readily be extended, and conclusions of universal application reached without other resource than that found within one's self. Beginning in the home, one's conclusions will be found to extend to the town, to the county, to the State, to the world. One may finally think about the universe. The spirit in which these investigations are conducted will be that of an inquiring child. It is literally true in science that "a little child shall lead them." The men who have built it up have labored successfully in exact proportion as they have put their questions directly to Nature rather than to books and to the sages. The most hopeful sign that the growing scientific mind can disclose to its fellows is that increasing simplicity of heart and mind which has characterized all the immortals recognized by science. It is this very faculty that has made men of science so notoriously incompetent in business matters. We have come to expect little news from a sharp bargainer.

Questioning Nature in this childlike and natural fashion, life becomes again a daily revelation, and inspiration a contemporary event. It is paradise regained. There are still suffering and sorrow, but there are also their antidotes, hope and faith. There is universal law, but there is also universal love. The severe harmonies of the universe lend grandeur and dignity to the pass-

ing moment. One feels that the destiny of man is assuredly noble.

The student will not go far in his quest before facts begin to accumulate which are fraught with the deepest significance. He has known perfectly well all along that only a certain amount of heat can be obtained from burning a definite quantity of coal, and that it will be given out in proportion to the rapidity with which the burning is accomplished. If he wishes his room to be warmer, he opens the draught and gives a more abundant supply of air to the fire. The operation has been too often repeated to excite any wonder. But it becomes significant when he discovers that all other chemical reactions rest upon precisely the same principle. Each substance is found to have a definite combining power, and in every reaction, however simple or complex it may be, a definite quantity of one element unites with a definite quantity of another. If too much of either element be taken, it will be left over. But this is the law of definite proportions discovered by Dr. Dalton in the early part of the century and now the very corner-stone of chemical science. If the student further inquire what has become of the coal and the oxygen whose union we call combustion, he will find that a colorless gas, carbonic-acid gas, has been formed whose weight is exactly equal to the sum of their weights. Other illustrations will yield parallel results, and the far-reaching conclusion will be forced upon him that man is neither able to create matter nor to destroy it. This single truth once really apprehended gives a stability to thought which can scarcely come from any other single consideration. The universe is seen to be in an eternal ebb and flow, but its materials are seen to be constant. Once persuaded of the fact, and the suspicion arises that the same may be the case with heat and other forms of motion. And such he finds to be the truth. He learns that energy likewise is neither creatable nor destructible, and that all the work going on in the universe is simply that of transformation. New distributions of motion and new combinations in matter, these make up the cosmic life, but the sum total in each case remains unaltered. Perpetual motion is seen to be more than a possibility; it is found to be a necessity. One sees all of the universe in a state of ceaseless flux, sees that nothing stands still, that growth involves never-ending change, and becomes prepared to accept without fear those changes of opinion which intellectual growth necessitates as well as that great change of state which we call death. I can not hold as idle or of secondary import the speculations which these considerations engender. It is good for a man to penetrate as far as he may into the established order of the universe, for its secret is his secret, its process is his process. Curious thoughts spring from brooding over these doctrines of the conservation of force

and matter. If in imagination we go back to that early time when our little planet was thrown off from its parent sun, we see, in the nebulous stuff from which it has precipitated, the materials of our own bodies. We are conscious of having had part in that wonderful birth, of having been present at the creation of the earth. It is true that we were very absent-minded at the time, but nevertheless our interest in that little ball of glowing vapor sent whirling off into space was even then a very personal one, for it was the aërial ship that carried our own destinies. If, then, the smallest atom that to-day forms a part of the delicate organism which we hold to be the tool of an indwelling spirit, has existed from all time, and is pledged to all eternity, it is difficult for the student of nature to conceive that the intellect which has given worth and dignity to this otherwise inanimate mass of matter should not be equally enduring. He is led to believe in an immortality of spirit which has known no beginning and will know no end. He is brought to what may be called the doctrine of the conservation of soul.

It has been a dream of poets and philosophers that there is in all the universe but one true element, and that the so-called elements—what we know as gold and silver, copper and iron, hydrogen and oxygen—are but modifications of this one primordial unit. The chemists of the nineteenth century are turning poets and dreaming this dream over again. What would have been scorned but a few years ago as alchemists' madness is now orthodox science. It is hard to believe that such a heavy, infusible metal as platinum has anything in common with a light, combustible gas like hydrogen; but, when we come to think about it, it is still harder to believe that the two are unrelated. When it is found that such dissimilar substances as charcoal, graphite, and diamond are chemically identical, it is quite possible to believe that all the elements are the products of a chemical evolution that has perhaps started with the element "helium," which the spectroscope discloses in the atmosphere of the sun. Thus the belief in the essential unity of the universe grows apace, and the cosmic drama gains in wonder as it gains in simplicity. What Goethe has called "the open secret of the universe" stares every man in the face. As one follows the wonderful story of its mode of becoming, and traces the far-reaching harmonies and relations, he is moved to exclaim with the devout Kepler, "O God, I think over again thy thoughts after thee!"

These considerations by the way, have for their sole purpose the indication of what I feel to be the rational mode of approach to the study of chemistry. It is a science so competent to become a means of keen intellectual pleasure and a stimulus to the most profound thinking, that its neglect by all but special students

seems to me the neglect of a source of inspiration that one can ill afford to slight. Pursued in the spirit that I have tried to indicate, as a natural extension of the experimental knowledge of childhood, and through the medium of a few substances thoroughly studied, I venture to recommend it quite as highly as a means of culture, as an end valuable in itself. It would be an easy task to extend such considerations indefinitely; but I want rather to open the right door into chemistry, than to decorate its vestibule. "It is a foolish thing," says the author of the Book of Maccabees, "to make a long prologue and to be short in the story itself."

THE PHYSIOGNOMY OF THE MOUTH.

By TH. PIDERIT.

THE muscles of the mouth have a triple function. They serve in the articulation of sounds, and assist the activity of the taste and the hearing. Our present study is limited to the movements of the buccal muscles, which have to do with the taste. Taste is the earliest developed of all our senses, and abides with us from the first to the last hour of life. No other sense controls man so early or with so much power; none remains so long faithful to him.

The lips may be regarded as a flat, circular muscle placed in front of the buccal cavity, cleft horizontally in the middle, with a moist, ruddy mucous membrane covering the edges of the opening thus formed. Not regarding now the muscles of the lower jaw, the mouth is closed by the contraction of the orbicular muscle of the lips, and opened by antagonistic muscles which are fixed on its outer edge. The mouth is, then, destined to undergo very great variations of form; and, by virtue of this variety of its movements, it enjoys at least as much importance as the eyes in whatever concerns the mimetic expression of the countenance.

When any object perceptible to the taste is placed upon the tongue at rest, the sensation of the contact is vague and imperfect. It is only when the upper face of the tongue is pressed against the osseous vault of the palate that a complete impression of the object can be made upon the nerves of taste, the extremities of which abut upon the caliciform papillæ of this surface. Hence, when in mastication we inopportunely encounter anything of disagreeable taste, we at once separate our jaws to get the tongue as far as possible from the palate or to prevent any further rubbing of the upper face of the tongue and repetition of the bad taste. The movement of the jaws is accompanied by a corresponding movement of the mouth. The upper lip is removed

from the lower lip as the palate is removed from the tongue by the levator muscles of the lip and of the wings of the nose drawing it up. Each of these two muscles rises near the inner corner of the eye, and ends in two points—one of which is attached to the wing of the nose, and the other to the middle lateral half of the upper lip. When these muscles come into play, the expression of the face is modified in a striking manner. The red edge of the upper lip is drawn up in the middle of its upper half, and this part of the lip is turned over, so as to give the line of its profile a broken appearance. The wings of the nose are raised, and the naso-lateral grooves, which, beginning at these wings, continue in an oblique direction to the commissure of the lips, appear near their beginning strongly pronounced and unusually straight. A still further effect of the movement is an even folding of the skin of the back of the nose (Fig. 1). The expression thus depicted, appearing primarily with bitter tastes, is also associated with other disagreeable feelings, which have become characterized by the term *bitter*.

While in ordinary disagreeable representations and dispositions the skin of the forehead alone is wrinkled vertically, the bitter trait of the mouth also appears in such as are very disagreeable (Fig. 2). The significance and importance of this expression

FIG. 1.—BITTER EXPRESSION.

FIG. 2.—BITTER EXPRESSION, WITH VERTICAL WRINKLES ON THE FOREHEAD.

vary essentially according to the nature of the look. If it is dull, the face bears the impress of bitter suffering, and it is a sign that the person is suffering from bitter feelings and trials; but if it is firm and energetic, the face then wears the marks of lively reaction and violent irritation. When the eyes are directed upward in ecstasy, the vertical wrinkles are of course absent, and then, while the upper lip is contracting bitterly, the face expresses a painful concentration. Such is the expression which painters have sought or should have sought to represent in the penitent

Magdalen. If, instead of vertical wrinkles, horizontal furrows appear on the forehead while the mouth is wearing the bitter trait, we recognize that the man is occupied with painful recollections.

The physiognomy is most violently changed when the expression of fear is manifested simultaneously with the bitter trait, or when the vertical and horizontal wrinkles both appear on the forehead at once. In this way the countenance receives the expression of violent terror. Leonardo da Vinci describes this expression in very striking terms when he says: "Paint wounded and bruised persons with pale faces and elevated eyebrows; the whole, including the flesh above, covered with wrinkles, the outside of the nostrils with a few wrinkles ending near the eye. The wrinkled nostrils should raise themselves and the upper lip with them, so as to expose the upper teeth, and these, parting from the lower jaw, will indicate the cries of the wounded." Darwin describes other symptoms of terror and fear as follows: "The heart beats quickly and violently, so that it palpitates or knocks against the ribs. . . . The skin becomes instantly pale, as during incipient faintness. This paleness of the surface, however, is probably in large part or exclusively due to the vaso-motor center being affected in such a manner as to cause the contraction of the small arteries of the skin. That the skin is much affected under the sense of great fear we see in the marvelous and inexplicable manner in which perspiration immediately exudes from it. This exudation is all the more remarkable as the surface is then cold, and hence the term a cold sweat, whereas the sudorific glands are properly excited into action when the surface is heated. The hairs also on the skin stand erect, and the superficial muscles shiver. In connection with the disturbed action of the heart, the breathing is hurried. . . . One of the best-marked symptoms is the trembling of all the muscles of the body. . . . From this cause, and from the dryness of the mouth, the voice becomes husky or indistinct, or may altogether fail. 'Obstupui steteruntque comæ, et vox faucibus hæsit'" (I was amazed, my hair stood up, and my voice stuck in my throat). This form of mouth occurs physiognomically among persons of a soured nature.

The sweet trait is opposed to the expression of bitterness; for while that seeks to avoid as much as possible a disagreeable sensation of taste, in it the muscles are set to play in such a manner as to gather up the gustatory impressions as completely as possible. The mouth is closed and the cheeks are strongly pressed against the teeth, so as to concentrate and retain upon the tongue all the parts of the sapid object, which during mastication and degustation glide between the cheeks and the jaws. In this way the activity of the nerves of taste is greatly assisted. The cheeks are pressed against the teeth chiefly by the action of the same

muscles as are exercised in laughing, and for this reason the sweet trait bears a degree of resemblance with the trait of the smile; but the simultaneous contraction of the orbicular muscle of the lips suppresses to a considerable extent the lateral effect of the laughing muscles. The most essential characteristic, however, of the sweet trait is the peculiar form assumed by the lips; their orbicular muscle being drawn closely against the teeth, the red lips lose their normal swell, so as to appear flattened and straight when viewed in profile (Fig. 3). The mouth is drawn up in this way under the influence of unusually agreeable, sweet tastes, and also as a mimic expression of extremely pleasant feelings in the representations and recollections to which the usages of language have given the epithet of sweet.

FIG. 3.—SWEET EXPRESSION.

The sweet mouth, combined with an enraptured look, gives the mimic expression of a pleasant reverie; joined with a sly look, the expression of amorous coquetry; with horizontal wrinkles it suggests occupation with pleasant thoughts or recollections. It frequently appears when the lips are prepared to give a real or feigned kiss. Inasmuch as the very agreeable feelings to which the term sweet is applied are of only exceptional occurrence, this trait is rarely developed physiognomically. It hardly ever exists among men, but is occasionally found among extremely affectionate women. When it becomes constant upon the face, it produces an impression akin to that of a too constant sweet taste, as if there were too much of it. If we observe the trait plainly impressed upon a person, we shall be likely to find him in conversation making much use of the word sweet, and speaking of "sweet women," "sweet music," "sweet love," and even of "sweet grief."

The central fibers of the orbicular muscle are capable of contraction independently of the lateral fibers, and this movement gives the scrutinizing trait. When we are on the point of tasting a sapid substance, such as wine, we introduce it between the lips projected into the form of a muzzle; we then carefully let the liquid flow slowly upon the upper surface of the tongue, in order that the impression of the taste may be prolonged as much as possible, and we may gain more time to appreciate it. The same expression may be observed on the faces of men who are examining the value of an object, whether it be something perceptible to the senses, or abstract thoughts or associations. The art critic

looking at a picture, the doctor feeling the pulse of his patient, the judge weighing the testimony of a witness, the merchant deliberating concerning the acceptability of a commercial proposition—all are tempted involuntarily to project their lips, as if about to taste something sweet, and that the more readily as they fancy themselves better qualified to form a judgment. This trait furthermore betrays a kind of feeling of one's own value, a feeling of superiority; for whoever considers himself authorized and fit to pass a definite judgment on men, things, or events at once feels that by virtue of his quality of judge he rises superior to

FIG. 4.—SCRUTINIZING EXPRESSION.

FIG. 5.—SCRUTINIZING EXPRESSION, WITH VERTICAL WRINKLES.

FIG. 6.—SCRUTINIZING EXPRESSION, WITH HORIZONTAL WRINKLES.

the object on which he is called to pronounce. For this reason the scrutinizing trait is also often the expression of arrogance and presumption (Fig. 4). If the scrutinizing trait is associated with vertical wrinkles, it indicates that, while the man is weighing and studying the reasons for and against the judgment he is to pronounce, whatever may be his final decision, he is already in a bad humor (Fig. 5). With horizontal wrinkles, the scrutinizing trait indicates that attention is fixed in the highest degree upon the matters that are under examination, and that they are considered very important or very delicate. A fine representation of this expression is given in Hasenklever's picture, "La Dégustation du Vin" ("The Wine-tasting," Fig. 7). This expression is frequently found among men who think much of the pleasures of the table. Their imagination indulging in fancies of pleasures obtained or anticipated, their lips advance as if they were really tasting what they are imagining; and thus the scrutinizing trait becomes physiognomic. It is also developed in men who have a high idea of their own value, and feel called upon to judge concerning the value of other men.

When we make any very violent bodily effort, as to put on a tight boot, or to open a tightly closed door, besides contracting the muscles of the arm, we stiffen the neck, clinch the teeth, and press the lips close upon one another. It is very evident that these muscles do not in any way contribute to the attainment of the end proposed; but at the moment when the man is calling upon all his strength and energy to overcome a difficulty by means of a bodily effort, the intensity of his will is manifested not only in the muscles that serve to produce the desired effect, but also in all the muscular apparatus of the body. Every muscle contracts; and, of course, the contraction of the weaker muscles is neutralized by that of the smaller ones. These simultaneous movements, without intention or object, appear more evidently in the facial muscles, and notably in the vigorous muscles of mastication. In all violent or difficult movements we are accustomed, by the contraction of the muscles, to press the lower jaw against the upper, as if we were tearing or breaking some hard object.

FIG. 7.—HEAD FROM HASENKLEVER'S "WINE-TASTING," SCRUTINIZING EXPRESSION.

The fact that we have noticed in connection with the bitter trait—that the movement of the lower jaw is accompanied with a similar movement of the mouth—is likewise observed in the pinched trait. As in the former case we remove, as far as possible, not only the upper maxillary from the lower maxillary, but also the upper lip from the lower; so, in the latter, we press the lower maxillary against the upper, and the lower lip against the upper. In consequence of the contraction of the orbicular labial muscle and of the incisor muscles, the lips are closely shut and their red edges are turned within; but at the same time the lower lip is energetically pressed against the upper, by the action of the two levators of the chin. These muscles start from the upper edge of the lower jaw, near the median incisives, directing their fibers downward and outward, and lose themselves in the skin of the chin. They lift the middle of the lower half of the orbicular labial muscle, and press the skin of the chin closely against the bone. In consequence of this movement, the middle of the lower lip seems to be raised, and simultaneously two wrinkles or indentations appear, which, beginning at the middle of the lower lip,

are directed thence toward the sides, like the sides of an obtuse-angled triangle, in a straight line downward and outward. These two indentations are very characteristic of the pinched trait, and correspond with the lower border of the tense labial orbicular, drawn up in its middle (Fig. 8). This expression is, however, provoked not only by very intense corporeal but also by very intense intellectual efforts. The efforts, however, which we make in mental works—in scientific researches, for example—are rarely passionate enough in their nature to bring on a spasmodic pressure of the lips and teeth; but this takes place when we dispose ourselves for an intellectual combat, when one appeals to all the force of his will to defend himself against strange influences and guard his own convictions. The mouth closed firmly, with the lower lip raised, gives the expression of tenacity, stubbornness, obstinacy, and perseverance.

FIG. 8.—PINCHED EXPRESSION.

A person having his teeth and lips closely shut and the skin of his forehead contracted at the same time into vertical wrinkles, shows that he is angry, and firmly disposed to contend about the matter that is on his mind (Fig. 9). If his lips are pinched and

FIG. 9.—PINCHED EXPRESSION, WITH VERTICAL WRINKLES.

FIG. 10.—PINCHED EXPRESSION, WITH HORIZONTAL WRINKLES.

his eyebrows lifted up, he is trying to maintain the impressions that have determined him to an obstinate persistence in his opinions and intentions (Fig. 10). In J. Schrader's picture, "Gregory VII in Exile at Salerno" (Fig. 11), the tenacity of the mouth, the anger expressed in the vertical wrinkles, and the tense attention in the horizontal ones, joined with a secretive look, give to the face of the character the expression of a dangerous man who is contemplating perfidy and vengeance. Another combination is

that of the pinched trait and vertical wrinkles with the bitter expression of the mouth (Fig. 12).

It remains to describe the complicated muscular movements that accompany a violent rage. The jaws are strongly pressed upon one another, in expression of an energy ready for the com-

FIG. 11.—PINCHED EXPRESSION, WITH FURTIVE LOOK; HORIZONTAL AND VERTICAL WRINKLES.

FIG. 12.—PINCHED EXPRESSION, WITH BITTER, AND VERTICAL WRINKLES.

bat, of a provoking resolution; the upper lip is elevated and also the wings of the nose (bitter trait) so high that it is impossible to pinch the lips; and the teeth of the upper jaw are seen above the upward-drawn lower lip. The nostrils are swelled out wide, for the movements of respiration and the heart are precipitate in rage, and the air is inhaled and expired violently to meet an obstacle in the tightly closed teeth, so that the breathing, preferably done through the nose, is facilitated by the inflation of the nostrils. The forehead presents horizontal wrinkles as a sign of close attention, and vertical wrinkles in expression of anger. The eyes look brilliant and "flash with fire" under the effect of the mental excitement, roll wildly in their orbits, or cast a fixed and piercing look (Fig. 13).

FIG. 13.—PINCHED EXPRESSION, WITH BITTER. EYES WIDE OPEN, VERTICAL AND HORIZONTAL WRINKLES, AND WINGS OF THE NOSE SWELLED OUT (EXPRESSION OF FURY).

The pinched trait becomes physiognomical most easily and frequently with persons whose daily occupations involve often or for long periods painful or intense bodily efforts, whether in the shape of a great display of force, or of special care and prudence. It may be developed among blacksmiths as well as among embroiderers, among butchers or sculptors; but we may be sure that persons with whom we find it

are accustomed to do work with zeal and conscientiously. This trait can not, however, be developed physiognomically as the result of intellectual efforts and the expression of tenacity, except the corresponding states of the mind are repeated not only often but with duration. We recognize in them the *tenacem propositi virum* (man tenacious of his purpose) of Horace, the persevering man; and also, when the expression of the pinched air is engraved with a particular force, the opinionated, obstinate, headstrong, hardened man.

The expression of contempt, or disdain, is manifested partly in the eyes and partly in the mouth. A person who wishes to show his contempt raises his head in order to cast his look downward upon the object of his scorn; he thus expresses that he feels superior to the one who appears low to him—only he does not look straightforwardly at the object, but sidewise, as if he did not judge it necessary to turn his head in order to fix his eyes upon him; at the same time the eyelids droop as in sleepiness and as a sign of extreme indifference toward the real or imaginary cause.

FIG. 14.—EXPRESSION OF CONTEMPT.

Still, a certain degree of idle and constrained attention is recognizable in the stretched appearance of the frontal muscles; the eyebrows are drawn up and horizontal wrinkles are formed on the skin of the forehead (Fig. 14). Thus, a feeble degree of contempt is expressed only in the eyes, but in the rising degrees of a haughty disdain the expression of the mouth becomes modified in a peculiar way. The bitter trait appears in the upper lip, as if the person were feeling a disagreeable, nauseating taste, and simultaneously the lower lip is pushed forward and upward, as if in the desire to remove an insignificant object from the neighborhood of the lips. The sign that the object is regarded as very insignificant is derived from the fact that in elongating the lower lip we are accustomed to blow a little puff of air, as if that were enough to blow away so light an object. Hence the mimic expression of contempt is a complicated one, and is related partly to imaginary objects and partly to imaginary sensorial impressions.

As in the pinched trait, the lower lip is likewise drawn up in the trait of contempt, and in both cases by means of the two levator muscles of the chin. The expression of stubbornness, however, is essentially distinguished from that of contempt by the lips being drawn inward, while in contempt the lower lip is pushed forward. This is due to a combined action of the levator muscles and of the triangular muscles of the chin; while the

former push the lower lip upward and the corners of the mouth are depressed, the red edge of the lower lip is turned outward. Under the influence of the levator muscles of the chin, wrinkles characteristic of the lower lip are formed in the expression of contempt as well as in that of stubbornness; but in the latter the wrinkles start from the middle of the lower lip and are directed in a straight line toward the base and outward, like the sides of an obtuse-angled triangle, while in the former they form, by tension toward the base of the triangulars of the chin, a curved line, the convexity of which is upward (Fig. 15). In both expressions the chin is flat, because its skin, under the influence of the levator muscles, is drawn upward and tightly stretched.

FIG. 15.—CONTEMPTUOUS EXPRESSION IN THE MOUTH.

If vertical wrinkles appear along with the expression of contempt, and the arched eyebrows and horizontal wrinkles are wanting, we judge that the person is under the influence of both anger and contempt (Fig. 16). The expressions of contempt and bitterness may be combined, as signs of a corresponding complexity of feelings. The expression of contempt occurs physiognomically with pretentious, arrogant men, who are accustomed to measure the conditions and opinions of others by the scale of their own imagined excellence, and who are hard to satisfy. This trait is manifested in the eye by highly arched brows, horizontal wrinkles, and depressed lids. In the mouth, we perceive that the middle of the lower lip seems pressed up, and that under its red border, which is slightly thrown out, an arched wrinkle is developed, the convexity of which is turned upward.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

FIG. 16.—CONTEMPTUOUS EXPRESSION, WITH VERTICAL WRINKLES ON THE FOREHEAD.

IN a work on the "Constitution of Celestial Space," M. Hirn deals with the question of the existence of an ether and its possible tenuity. Among the curious conclusions that he reaches is one that the density of a medium capable by its resistance of causing a secular acceleration of half a second in the mean velocity of the moon, would correspond with a kilogramme of matter uniformly distributed throughout a space of about three hundred and ninety thousand square miles. This is a density one million times rarer than that of the air reduced to one millionth of its normal density in Mr. Crookes's apparatus.

THE MEANING OF PICTURED SPHERES.

By J. C. HOUZEAU.

WHEN we take up a treatise on astronomy and come to the description of the constellations, we meet an amazing system of nomenclature. The celestial sphere is represented as covered with fictitious figures of all sorts of personages and objects, to which the stars are referred. There are heroes, like Hercules and Perseus; women, like Andromeda, Cassiopeia, and the Virgin; a giant, Orion; simple workingmen, such as a charioteer and a herdsman; a considerable number of animals, including two bears, a lion, a bull, a serpent, a crab, and a scorpion; monsters, like the dragon and the capricorn; and various inanimate objects, from a crown and a harp to a river. No other science offers so singular a system of nomenclature, so far outside of scientific conceptions. In botany, zoölogy, and topography, objects have distinctive names. We are universally accustomed to apply to the things we speak of designations that belong to them; but a system by itself, a figurative nomenclature, is applied to the groups of stars. This is a unique exception in the sciences. It is furthermore remarkable in this exception that it has held with all peoples who have made or begun a description of the sky. While the work may have been executed in isolation and in ignorance of the way followed by other nations, and the figures employed may be distinct, original, and inspired by the character of the people, the system of figuration has been the same.

There must evidently exist a cause of a general nature which has directed the thought of man in this always identical direction. There must be some feature in the aspect of the constellations different from those of other collections of natural objects and conditions which provoke a distinct work of the intelligence. This feature and these conditions we are concerned to find. It would have been no more strange to apply a figurative nomenclature to topographical groups than to the stars. Persons who first arrive in previously uninhabited countries are obliged to give names to the landmarks of the region which they will occupy; they have to distinguish the rivers and their affluents, the mountains and rocks. A chain of mountains might, perhaps, be more justly compared to a dragon than the file of stars that bears that name. The first mountain of the range might be the head of the monster, the second the neck, and the last the tail, while the lesser chains might be called the flippers or feet. This possibility is not to be rejected, for traces of a similar application are to be found in Formosa. The Chinese have, according to Ritter, put

upon some of the Ta-Shan Mountains, which compose the nucleus of that island, the forms of men and figures of gods. But this is an isolated case.

When we pass to uranography, the figurative system becomes generally applied. It is well understood that the Greeks borrowed from the Chaldeans the general idea if not the details of their astronomy; and we accept their pictured sphere. Other peoples of antiquity likewise had their figured spheres, formed on the same principle—only the stars were differently grouped by each people according to its fancy, and the symbols chosen were different. Nothing better proves the independence of these constructions than this, but nothing also is more suited to exhibit what there is remarkable in this community of systems.

The Egyptians had a pictured sphere in very ancient times. Signs of it may be seen in the tomb of Seti I, at Biban-el-Moluk, and considerable developments of it in the calendar sculptured on the ceiling of the tomb of Ramses IV, at Medinet Abou. There are on this monument, which is of the thirteenth century B. C., a series of constellations designated by imaginary figures. Among them are a river, an arrow, and a lion which differs from that of our classical sphere. There are a hippopotamus and a lute-bearer; with a great asterism extending over nearly a quarter of the circumference of the sky, called the god Nacht, or the Conqueror, carrying a set of arms and ascending a stepping-stone. Another personage, Mena, is surrounded by servants. Egypt, therefore, in its uranography most distinctly followed the system of a pictured nomenclature.

The Aryans of India did the same thing in another independent manner. We find, among other things on their sphere, which was completed in the ninth century before the Christian era, a stork, two swine, a large tree with a dog in it, an Ethiopian with a giant's features, and a woman covered with a cloak. The Chinese adopted the system of small groups, and consequently considerably multiplied the number of denominations, so that their sphere bears more than three hundred names—names of personages and objects—forming in fact a figurative system. Here are the celestial pivot, precious stones, a bushel-measure, a woman embroidering, the sovereigns of the sky, and a number of the dignitaries of the Celestial Empire. The Arabs, previous to the time of Mohammed, also had a figured nomenclature, with a camel, a jackal, a sheep, an ostrich, and a dog; among inanimate objects, a tent, a crib, a pot, a plate, a cubit, and a well-bucket. The Great Bear was a coffin, followed by the three stars in the tail as three mourners. While the groups were independent and the figures unlike, the system of figuration still prevailed.

These peoples all had complete uranographies, covering every

part of the sphere that they could perceive above their horizon. Others, of a less advanced civilization, only named the more conspicuous groups of stars. They merely made a start. Yet the problem presented itself everywhere under the same aspect, for the solution was much of the same kind. Thus, the Scandinavians had a dog, a chariot, a cross, and a spindle in the sky. The Eskimos put seal-hunters there. The Makah Indians of the strait of San Juan de Fuca, living on the sea-coast, chose figures of fishes and cetaceans. The Aztecs and Mayas saw animals there, including a scorpion, which does not correspond with our constellation Scorpio. The Peruvians designated a jaguar, a cross-bearer, and a sheep suckling her lamb. The Puelches of Patagonia set ostrich-feathers in the Magellanic clouds. The Oceanian peoples applied figures to the constellations that impressed them.

These facts will lead the reader to ask if the resemblance presented by the configurations of some of the stars with familiar objects has not provoked comparisons of which the pictured sphere is a result. Thus, the constellation Gemini is composed of two lines of stars, each beginning with one of the first magnitude. There is a striking duality in this, which has seemed to suggest the same representative idea in many quarters. But the Accadians, who gave us the constellation of the Twins, did not figure it as we do, nor as the Tahitians do. Instead of arranging the brothers side by side, they opposed them foot to foot.

The small number of similitudes that we meet in the spheres of peoples distant from one another have an important significance. The Pleiades were nearly everywhere the first group that was remarked and named. The agglomeration of stars in it was of a nature to provoke the same kind of impressions. Yet different peoples attached different figures to it. The ancient Egyptians were struck by the idea of number, and, running into a prodigious exaggeration, called it by a name that signified thousands. In India they saw a hen and chickens in the group. This name spread thence to western Asia and then to Europe, and is still common. The similitudes were different in the New World. The Eskimos called the group the "bound together"; in a great part of North America the thought is of a dance—with the Iroquois, of men and women; with the Chokitapias, or Blackfeet, a sacred dance around the sacred seed. We may pertinently recollect that in classic antiquity Hyginus said that the Pleiades were so disposed as to seem to be dancing around.

The second stellar object that impressed primitive peoples is the milky way, which naturally suggests the idea of a road and a river. It is called the celestial river in China. To the ancient poets it was the stream of milk which Alcmene spilled when nursing Hercules. To the philosophers it was the highway of souls,

and had two gates, at the two places where it intersects the zodiac. The souls entered the world by the gate of the Twins (which corresponds with the sign Cancer), and left it to return to the gods by the gate of Sagittarius (sign of Capricorn). It is a little remarkable that some of the American nations also called the milky way the highway of souls;* but it does not appear so singular upon reflection. The milky way certainly resembles a road in its shape. Let us now recollect that a large number of people consign the souls of their ancestors to the sky; hence the idea might easily have occurred frequently. There has also been a fortuitous and unconscious agreement among nations to give the name of the Bear to the most brilliant constellation in the neighborhood of the north pole. The primitive Sanskrit name of this constellation, according to Prof. Max Müller, meant "chariot," and this was the original image, which survives among some of our people to the present. But as the same word, *riksha*, also designates a bear, there has sometimes been confusion, and the image of a bear was placed by the Greeks on the classic sphere. A bear was also represented by the principal North American Indian nations in the quadrilateral of this constellation. Only, these nations, who were familiar with the bear, did not include in the same constellation the three stars of what we call the tail, because the bear has only a very short tail, and this inclusion would have made it monstrous; so they fancied them three hunters pursuing the bear.

Now, is there anything extraordinary in the coincidence of like similitudes in the Old and New Worlds? We do not think there is. The bear is a polar animal. The constellation is large, and demands a large symbol. Facts prove this, for the constellation was a reindeer with the Eskimos, an elk with the Indians of Puget Sound, and an elephant with the Hindoos. The fortuitous coincidence of names in two different centers does not, therefore, seem hard to explain. It only implies that there is a resemblance with the adopted image in the aspect of the constellation. We should also consider that, within the limits of a certain compass of ideas, the number of objects to which it is possible to recur is restricted, and two peoples may be led by chance to select the same symbol for the same group of stars. This is visibly the case with the constellation Cancer, which is represented in Japan by another crustacean, the many-fingered limulus.

I shall not insist upon the coincidence which La Condamine thought he had found, respecting the constellation Taurus, among some of the Indians of the Amazon. It is now understood that the term by which these Indians designated the Hyades did not mean a bull's jaw, but a tapir's. The examples of identity or of

* J. F. Labitau, "Mœurs des sauvages Amériquains," 4to, 1724, vol. i, p. 406.

seeming identity in the images are therefore reduced to a small number of comparisons. They are exceptional cases, in which the aspect of the asterism may have had something to do with the suggestion of similar images. Aside from this there is nothing in common: the figures set in the sky upon the constellations were peculiar to each people; they were arbitrary creations, and that proves that the outlines formed by the stars did not directly suggest either personages or animals by which the imagination was struck. Apart from a few geometrical figures—a quadrilateral, a triangle, or a cross—the configurations of the stars presented no relations with the objects selected to designate them. We are dealing, then, with a fanciful creation by each people, in which each one exhibited the peculiar tendencies of its imagination and genius.

This circumstance renders the nomenclature in question still more remarkable, since there is nothing or hardly anything in the aspect of the celestial tableau to provoke the construction of it. We return to the question with which we started: By what cause has a nomenclature so strange, unique in its kind, possessed, in a seemingly inevitable way, all the peoples who have looked into the sky? For we might predict, from the generality of the method, that if some new people, having everything to begin again, should start to construct its system of knowledge, it would again make a pictured sphere for the stars. I will not pretend to answer a question of scientific archæology that has not been sounded, not even outlined, till now. If I suggest a solution, it is simply as an essay and hint, leaving it to professional students of folk-lore to enlighten us more fully. It sometimes seems to me that we might draw some indications of a comparison between the manner in which places in hitherto uninhabited countries are named and the nomenclature of the stars.

When immigrants arrive in countries without inhabitants and unmapped, the first names given to the natural landmarks—the rivers, hills, clumps of trees, and rocks—are descriptive ones. These names often survive after the first arrivals have been dispersed and replaced by other peoples; and we know how ethnographers find, in geographical appellations, the track, the limits, and the language of the ancient inhabitants of a country. In such primary nomenclature, they say, for instance, the blue water, the green mountain, the brown rock, the cedar wood, the steep cliff, etc. It was the natural course, which has been followed everywhere. Why has the human mind taken a wholly different course for the sky? Was it not because the multiplicity of objects and their great resemblance had exhausted the series of descriptive terms? Multiplicity often confuses the judgment; for it is known that the view of the sky conveys the impression

of a larger number of stars than are really seen there. We instinctively halt before the seemingly impossible task of finding distinctive epithets for so many stars and asterisms; for, after a few such qualifications as blazing, sparkling, pale, trembling, etc.—perhaps there are twenty of them in all—we find that words fail.

We suggest this explanation tentatively, without attaching particular importance to it. But we invite the serious attention of archæologists, and psychologists as well, to the singular phenomenon in mental evolution which the case of the pictured spheres discloses. It derives interest from its unique character as a nomenclature, and from its being reproduced, without exception, in all the centers of evolution. There is evidently something in the constant return of this process that comes from the very laws of our nature.—*Translated for the Popular Science Monthly from Ciel et Terre.*

SKETCH OF A. F. J. PLATEAU.

By SOPHIE BLEDSOE HERRICK.

ANTOINE FERDINAND JOSEPH PLATEAU was born in Brussels, October 14, 1801. He was brought up in the midst of artistic influences, his father having been a flower-painter of great talent. From his earliest childhood the boy exhibited not only remarkable ability, but clearly manifested the bent of his mind. When scarcely more than a baby he showed the greatest delight in some physical experiments which were made in his presence.

In the days when Plateau was a child, very little attention was paid to natural bent by parents in the selection of a life-work for their children. The idea of the hereditary transmission of occupation dominated all others. The boy, with no taste for art, was devoted at an early age by his father to the study of painting.

At fourteen years of age he became an orphan, and with his two sisters was left to the care of his uncle—M. Thirion, an advocate. Soon after this his health, which was never strong, showed signs of failure; and his uncle sent the children to a little village near Waterloo. It was upon the eve of the battle, and the villagers took refuge in the depths of the forest of Soignes, where for two days and nights they remained in the open air, sleeping at night before a great fire, and living upon potatoes which were baked in the cinders.

The boy seemed scarcely conscious of the violent detonations which shook the ground beneath them, he was so absorbed in his favorite pastime of catching butterflies. The panic over, the vil-

lagers went back to their homes, and Joseph and his sisters remained some time in the little village of Ohain.

As soon as his health was restored he returned to his art studies. Here he made such excellent progress that one evening Prince Frederick, the son of the king, who was visiting the establishment, was attracted by the boy's work. When he found that Joseph was an orphan, he said, "Well, from this moment I take you under my protection." Later, when M. Thirion wished to remind the prince of his promise, he was deterred by the boy's unwillingness to make any claim upon him.

Painting occupied Joseph by day, but in the evening and in his leisure moments his beloved physics employed all his time. With the aid of some young friends he organized *soirées*, the entertainment being experiments of his own devising, made with apparatus constructed by himself.

At sixteen years of age he entered the Athenæum at Brussels. He omitted certain studies, but in all that he undertook he distinguished himself by his enthusiastic progress. His masters became at once interested in their brilliant pupil. The friendship of Quetelet, which became stronger as time went on, proved of the greatest benefit to him in later life.

His school-life over, the subject of a profession presented itself for reconsideration. His uncle pressed upon the boy the study of law, as the noblest of all professions, and Joseph consented. In choosing art there had been no great sacrifice; he had been too young at that time to know his own mind; but he felt a strong antipathy to the law.

This dislike did not prevent honest and conscientious work in the pursuit of his legal studies; but the physical sciences held for him their old fascination, and he made the rather singular compromise of studying both law and physics, and doing himself credit in both alike. His faithful work had its reward at last: his uncle, seeing his determination, and at the same time his willingness to be guided, withdrew his opposition, and the young student gave himself up wholly to scientific pursuits.

The care of his younger sister now fell upon Plateau, and, pressed by the necessity to provide for them both, he accepted the professorship of elementary mathematics in the Athenæum at Liége. This was in 1827. In 1829 he received the degree of Doctor in Physical Sciences and Mathematics, and from that time he gave himself to original research.

During this year he devoted much time to experimenting upon various points in regard to vision, to the persistence of impressions upon the retina, subjective color, etc. On one occasion, to determine some point, he looked at the sun for twenty-five seconds with the naked eye. For many days after this hazardous

experiment his eyes were strongly affected, but he did not suspect that he had done them a permanent injury. This experiment undoubtedly laid the foundations of that disease which twelve years later brought on total blindness.

After being forced to resign his work, in 1830, he again resumed it at Brussels. In 1835 Quetelet urged Plateau to apply for the professorship of experimental science in the University of Ghent. The young *savant* refused at first to offer himself as candidate for a position in the first institution in his native land, pleading youth and inexperience; but later his scruples were overcome, and he received the appointment to the chair.

As soon as he began his work in Ghent, he found the collections of the university very poor and meager. He gave himself at once to the work of remedying this deficiency. In order to inform himself, he visited and examined minutely the most celebrated collections in England, France, and Germany. He addressed the Government and the inspector of the university, and pleaded his case so well that in the end—though it was only after long and wearisome labor—he succeeded in securing one of the finest physical cabinets in existence to the University of Ghent.

In 1840 Plateau married Mlle. Clavareau, daughter of a director of tax-collections. She was always a devoted wife and true helpmate to him. Outliving him, she was able to comfort, sustain, and help him when darkness settled over his life. In 1841 his son Félix, now Professor of Zoölogy and Comparative Anatomy in the University of Ghent, was born. During the same year the disease which ended in total blindness made itself felt. For two years he submitted to the most painful treatment in hopes of saving his eye-sight. The trouble which had attacked the right eye extended to the left. During these long months neither his terrible affliction nor his excruciating suffering ever drew a word of complaint from his lips.

The courage which showed itself in this heroic endurance was far from being merely passive. Nothing daunted by what, in a lesser man, would have ended his life's work, Plateau never lost courage. The future must have looked very dark even to his courageous spirit, but he gave no token of failure. Happily, all material anxieties were removed by the action of his countrymen. He was appointed "professeur ordinaire," and a little later a royal order, countersigned by M. Rogier, assured him of the enjoyment of the entire salary and emoluments of his position. A noble recognition of the man and of his services—a recognition fully justified by forty years of fruitful work, and by a series of discoveries "which have made Belgian science illustrious throughout the entire world."

As soon as Plateau found himself fairly out of the physicians' hands, with restored health, he resumed his experiments with ardor. He was most happy in finding co-laborers who gave him the most efficient and willing help. "Thanks to their generous co-operation," said he, "the career of scientific work remains open to me. I can, in spite of the infirmity with which I have been visited, put in order the materials which I have amassed, and even undertake new researches."

When this experimental work began again, Plateau showed at once that the clouding of his physical sight had only served to clarify his mental vision. At first he could not give up his independence, and for some time he wrote between metallic slips; his assistants soon learned to decipher the writing. Later, however, he gave up this habit, and contented himself with writing to dictation.

His temper was usually calm and equable; he never uttered a complaint on account of the many deprivations which his blindness imposed. He was bright and amusing in his conversation, and yet he was, as all thinkers are, in the main, sober.

His memory, which was naturally a good one, had become phenomenal by cultivation. It was only necessary to hear an ordinary poem read once or twice for him to be able to repeat it accurately. This gift was one of his greatest compensations for the loss of sight, and of incalculable benefit in his experiments made by the hands of others. His method, given by his son-in-law and biographer, G. van der Mensbrugghe, is as follows: In a day devoted to experiment, speaking of the latter years of the physicist's life, he says: "The old man's face is animated; he announces with admirable precision all the precautions to be taken that the apparatus should work. According to his often expressed desire, the assistant acquaints him successively with his operations, even to the smallest point. No manœuvre is left to his personal valuation. The apparatus is at last ready to be set in motion. The master, who imagines and regulates all the dispositions, makes still other suggestions; he assures himself by different means that all is ready in accordance with his will. At last the assistant is asked to operate—the experiment succeeds! What a satisfaction, what a relief for the noble worker who has conceived it! For greater assurance he causes it to be repeated, with various modifications suggested by the descriptions of the observed effects. If all passes as he has foreseen, he at once asks his secretary to write to his dictation all the details of the experiment. No point is forgotten, for the provisional wording ought to represent, as exactly as possible, all that had been verified. But if the observation did not meet his expectations, in spite of the precautions he had deemed necessary, the physicist promised

himself to think it over again. He would then devote a part of the night to revolving the question again and again under all its aspects, to seek the cause of the failure and the means of future success."

His enthusiasm would sometimes put his assistants' patience to a rather severe test, and he would cry out, "Oh, if I could only *see!*" but as soon as success crowned his efforts, the indefatigable experimenter loved to express his gratitude. He cross-questioned Nature with more severity because he could only receive her answers by the voice of an interpreter. The thousand obstacles that presented themselves because of his infirmity only suggested a thousand precautions in order to surmount them. His inner vision was so preternaturally clear that he often corrected the observations of his assistants, and taught their eyes to see aright.

The love of scientific accuracy is not so much a mental as a moral quality. Plateau was possessed of a supreme love for truth, which not only made him accurate in his investigations and in the records of his experiments, but it made him careful not to judge others without a full knowledge of the facts. Always ready to ascribe scientific discovery to the right persons, he spared no pains to know who was the true discoverer.

The instructions which he gave to his pupils bore his own peculiar stamp. He used simple language and almost a conversational tone. His phrases were short, incisive, and clear, a fitting medium for the expressions of a mind so unclouded, so direct, and so concentrated. His talents as an experimenter were even more marked than as a speaker—more marked, because it is a far more uncommon gift.

He was an old-fashioned believer. The more deeply he "penetrated into the secrets of Nature, the more he inclined toward the mysteries of the supernatural order," says his biographer.

The picture of his home-life—his delight in and tenderness for his children in his early manhood, and the same gentle benevolence shown toward his grandchildren in his old age—is very beautiful.

As a scientist he is held in very high esteem by the greatest of his contemporaries. Honors were showered upon him by the great scientific societies of Europe. Such men as Arago and Faraday were glad to do him honor.

His earlier work was confined to the subject of the persistence of luminous impressions upon the eye and the determination of several simultaneous impressions under various conditions of motion. Many of the scientific toys of to-day are the outcome of facts and laws established by him, though he is not often accredited with these earlier discoveries. With the study of persistence of visual impression is so closely associated subjective color that

this soon came under consideration, both accidental color which follows an impression and that caused by juxtaposition. He simplified the subject greatly by making this division of the subject, the first class including all appearances which succeed the contemplation of a bright-colored object, the second those which accompany such contemplation. The phenomena had been observed before, but Plateau was the first who reduced them to law.

Some valuable experiments and formulated theories on the subject of irradiation were begun, but was interrupted by his oncoming blindness.

Before this time, Plateau's attention had been fixed by the spherical form which a drop of oil assumed when introduced into an alcoholic liquid having the same specific gravity as the oil. From this small beginning he developed a most wonderful series of experiments and laws under the title "Memoirs upon the Phenomena which a Free Mass of Liquid presents when removed from the Action of Gravity." Eleven papers upon this general subject appeared between the years 1843 and 1868 in the memoirs of the Academy of Brussels. These included his experiments upon films and the formulation of the laws which govern their union—one of Plateau's most valuable contributions to physical science. He also made some very interesting investigations upon liquid jets, with a number of shorter papers and notes upon various subjects. Most of these papers appeared in the memoirs or bulletins of the Academy of Brussels, a few in the French and German annals of science, "Comptes Rendu de l'Académie des Sciences de Paris," and Poggendorff's "Annalen." He died September 15, 1883.

It is impossible to read of Plateau's work, carried on for so many years in spite of frail health and total blindness, and not draw a parallel between Huber and himself—each of them a man who was the peer of any worker in his own field, though so cruelly handicapped. They are two of the purest, noblest, most pathetic, most heroic figures who adorn the annals of science.

WHILE believing it premature till some new groups of lines are further studied to express more than provisional suggestions as to the nature of certain nebulæ he has been examining spectroscopically, Mr. Huggins supposes that they may represent an early stage in the evolutionary changes of the heavenly bodies. They consist probably of gas at a high temperature and very tenuous, where chemical dissociation exists, and the constituents of the mass are arranged in the order of vapor-density. But the stage of evolution which the nebula in Andromeda represents is no longer a matter of hypothesis. Recent photographs show a planetary system at a somewhat advanced stage of evolution. Already several planets have been thrown off, and the central gaseous mass has condensed to a moderate size as compared with the dimensions it must have possessed before any planets had been formed.

CORRESPONDENCE.

A FALLACY OF THE SOCIALISTS.

Editor Popular Science Monthly:

DEAR SIR: Is not the land question, viewed from an American standpoint, simply a disagreement about methods rather than ethical principles; and are not the distinctions sought to be established between absolute and relative political ethics more subtle than philosophical or accurate?

A great part of the land in the United States was in the beginning, and much of it is still, just in the condition demanded by Mr. Laidler and his *confrères*—the absolute property of the Government. Almost the whole country was at first "held by the great corporate body—society," without any suspicion of "violence, fraud, the prerogative of force, or the claims of superior cunning" in any way affecting the sources to which titles are traced. Government was free to do as it would with its possessions: either to sell, lease, or farm them in its own behalf. Government—that is, society—chose to sell or give away the public domain in fee-simple, reserving the right of eminent domain. The moment land is reduced to private ownership, it becomes subject to taxation, and must bear its share of the burdens of society. It contributes toward the maintenance of roads, schools, infirmaries, hospitals, and all the complicated machinery necessary to the well-being of the social fabric. If land, subject to private ownership, fails to pay its tax assessments, it is forthwith confiscated and reverts to the state, which finally sells it, without possibility of redemption, to some other person who will pay the taxes—that is, contribute to maintain society. Who decides what amount of burden land shall bear? Not the private proprietor certainly, but society. No private owner can evade this implied contract—namely, to contribute as much to the support of society as society may deem necessary. Hence every citizen may be said to have an interest to the extent of his political or social influence in all the lands of the commonwealth. And the tenure of every landholder depends on his ability to meet the burdens laid upon his land by non-owners, since these everywhere constitute a majority. Strictly speaking, therefore, there is no such thing as private ownership of land in the sense in which the expression is used in the discussion. The owner may sell, lease, or bequeath his holding; but the usufruct of society, which exists prior to all other claims, can not be avoided. Mr. Laidler's assertion, therefore, quoting from Mr. Spencer, that if men may make the soil private property, "then the Duke of Sutherland may justifiably banish Highlanders to make room for sheep-walks," is fallacious. This false assumption invalidates equally all of the ten sections which compose his argument. As land tenures exist in the United States, the landless men, instead of becoming subject to "expulsion from the earth altogether," would be far more likely to bring about the confiscation of all of the duke's vast possessions by the legitimate exercise of their constitutional powers of direct and indirect taxation.

It may be urged that the existing tenure of land in the United States does not represent the status of private ownership in older and densely populated countries, and still less so that possible condition of the earth and mankind contemplated by the expounder of absolute political ethics. The obvious reply is, that neither condition is essential to the continuation of private ownership. Let the Socialists direct their complaints against hereditary privileges and the abuses of private ownership, and not against that coincident form of land tenure which, when properly adjusted, is best adapted to realize their views.

If all lands in Great Britain could be suddenly transferred to the crown, is there any way in which society could better manage or dispose of them than the United States has adopted? No better way, certainly, has yet been indicated. Government here—notably the State of Ohio in the management of her school lands—tried for many years all known methods of leasing these lands, and all ended in conspicuous failure. Her public men universally denounced the system of leases, after experimenting with it in all possible ways, until an act of Congress authorized the school lands to be sold. If society, after actual experience, has condemned and abandoned the methods advocated by the Socialists, and adopted the existing form of private ownership as the best which statesmanship has to offer, what reason is there to suppose that the resumption of public ownership, if it could be accomplished, would lead to better results in the future? Under the present form of private holdings, land is made to yield the largest possible returns, and to contribute of its products the largest possible contingent for the benefit of the landless. Can any theory of government or system of philosophy be true which is inconsistent with obvious facts?

JAMES L. TAYLOR.

WHEELERSBURG, OHIO, *December* 30, 1889.

A DEFENSE OF "ADVANCED" WOMEN.

Editor Popular Science Monthly:

I HAVE read the article by Grant Allen in the October number of "The Popular Science Monthly," and I wish to say that if I knew even one woman of "advanced" ideas

holding the opinions he attributes to them I should value the article in that proportion; but as I do not know a single one—and I have lived a good deal among women of "advanced" ideas—I can not help thinking the article worse than uncalled for.

As far as I know anything about it, those who shirk the duties of maternity have ideas very far from advanced: they are the poorer kind of society women, many of whom would be horrified at being suspected of intelligence or independence.

The charge used to be that women became spinsters because they could not get husbands, and that was considered sufficiently opprobrious. Now Mr. Allen charges them with unwillingness to take husbands; and yet states in the same breath that the marriageable men go off beyond reach when they "ought to be making love," etc.

Here is an arraignment indeed! Why not devote an article—any number of articles—exclusively to these marriageable men?

The great body of noble women who have thrown themselves into the struggle for equal freedom are behind no one in desire for true womanliness and femininity. Already we are well on the way to the emancipation that Mr. Allen pleads for, the sound bodies and minds that are to come from the free and entire development of girls and boys, and freedom from Mrs. Grundy; but all the progress made is due to these "women-question agitators."

If there exists this deplorable indifference to marriage on the part of women, is it not the consequence of the very state of things that these leaders are striving to abolish—and also, perhaps, of the sacrifices that this strife entails, and of some of the characteristics that are inevitably developed by it, and that no one knows or deprecates more than these valiant workers themselves?

All reforms have their attendant evils; but it is the state of things that called for the reform that is to blame for them—or the "nature of things."

We need patience, hands off, fair play without privilege, and that each should think most of his own duty. A. A. M.

BOSTON, *December* 15, 1889.

PUBLIC SCHOOLS AND CRIME.

Editor Popular Science Monthly:

As I have more than seven hundred pupils under my charge, and that, too, in a State not backward in common-school education, I venture to protest against being lodged in a criminal-making class. Like Mr. Reece, I would ask, "Of what utility are facts and experiences unless their teachings are heeded and their meaning properly interpreted?" With Mr. Atkinson, I say, "All statistics, unless qualified by sound judgment, are mere rubbish."

Mr. Reece mentions the fact of the increase of criminals since the period of modern civilization and science commenced, but he does not mention that the methods of tracking criminals have wonderfully increased, so that we may have a larger ratio of criminals *caught* than in days before the swift post, the telegraph, the police system, the photograph, and the extradition treaty. Surely he should give the public school the praise of supplying some of the means of catching the criminal after it has made him! I will say nothing about the increased accuracy of the statistics of 1880 over those of the earlier period.

While discussing criminality in New York State, he states that the common schools furnish eighty-three per cent of the inmates of Auburn and Sing Sing, while a little over nine per cent is credited to the illiterate population. Out of 2,616 convicts, 1,801 are credited to the common school and 238 to the illiterates. I can not see that even his own arrangement of the figures is against us. Surely nine per cent is a much larger ratio, when compared with the number of illiterates in New York, than eighty-three per cent would be if compared with the number of the common-school graduates. It seems to me that he should have taken as bases for his example in social arithmetic the number of illiterates and the number of common-school graduates. I have not the statistics of illiteracy in New York at hand, but I believe the figures will show fully three times as large a ratio of criminals to be credited to them as to the common school.

Mr. Reece cites various savage tribes as being examples to us in morals. He fails to see that temptations are increased a thousand-fold for the civilized man. There could not be many thefts where all property is held in common, when the property owned is so paltry as not to be worth the carrying away.

I do not contend that the public school is doing all it is able, but it is doing as well as the church and the family are doing in their spheres toward elevating the moral tone of the community. Writers like Mr. Reece seem inclined to find fault with us because we can not do the work of the family and the church. We are doing a good share of it, but, under the triple burden, we may sometimes fail to send out all good citizens. Very truly, CHARLES S. DAVIS.

LYNN, MASS., *January* 15, 1890.

A NOVEL WATER-COOLER.

Editor Popular Science Monthly:

MY article in the January (1890) number of the "Monthly" brought me an inquiry from Quincy, Illinois, as to where the writer could get an olla (pronounced *o*-ya), and what it would cost. Here in southern California they are plenty, and the regular retail price is twenty cents a gallon. What the transportation would be I do not know.

Since my article was written I have heard

of another way of keeping water cool, which I have never seen exemplified. A grain-sack, such as is used by the Eastern farmers, is painted and filled with water, and hung up in a cool place where the breeze strikes it.

The olla, too, must be kept in a breezy place. Wind will dry clothes or a field, and so it will evaporate the water oozing through an olla, or barrel, or, I suppose, the painted grain-bag. The evaporation is what does the cooling, according to a well-known principle of physics. HENRY J. PHILPOTT.

PASADENA, CAL., *January* 13, 1890.

THE LUCAYAN INDIANS.

Editor Popular Science Monthly:

SIR: With reference to Prof. Brooks's paper, "The Lucayan Indians," in the November number of the "Monthly," I have examined one or two caves during the past summer, and have been intending to make a more thorough search during the winter; so, if any of your readers should feel inclined to adopt the professor's suggestion, I shall be glad to co-operate.

Although no doubt the aborigines of the Bahamas had intercourse with Hayti and Cuba, the possession by them of stone implements does not, as Prof. Brooks supposes, prove it; for, although the islands consist solely of coral rock, yet stone, identical in appearance with that of which the stone implements are usually made, is constantly being washed up on the northern shore of New Providence, and probably elsewhere; so that the Lucayan implement-makers would have had plenty of material in the archipelago.

Also, it must not be too hastily concluded that all remains found in caves in the Bahamas are Lucayan. Negro skulls have been found more than once, and in one cave I found, consolidated into breccia, a number of bones which a local anatomist pronounced to be those of "some large vertebrate animal." They presented an appearance of great antiquity, and, had we not known that there were no large animals in these islands at the time of their discovery, they would certainly have been referred to pre-European days; whereas, they were probably the remains of an ox which had been killed and eaten by runaway slaves, for the surface of the rock showed traces of fire. Yours faithfully,

A. B. ELLIS.

NASSAU, N. P., *November* 23, 1889.

EDITOR'S TABLE.

HOW TO MAKE KNOWLEDGE REAL.

THERE was an interesting discussion a month or two ago at a meeting of the Chicago Institute of Education. A paper had been read by one of the members of the Institute, Mr. Fernando Sanford, on "The Disciplinary Value of Scientific Study," which is stated to have been a strong and well-constructed plea for the study of science by original observation rather than by the ordinary text-book methods. Many of our readers would expect that unqualified assent would have been given to the argument of the paper; but it happened that an eminent educationist was present in the person of Superintendent Howland, of the Chicago public schools, who dissented entirely from Mr. Sanford's thesis. He thought all this talk about observation of facts and handling of objects was great nonsense; why not let children learn out of books that things were so and so, and commit the facts to memory? What was the use of all the accumulated knowledge and intelligence of the ages, if children were to begin at the beginning and make over again for themselves discoveries that were made centuries ago? Life was too short, he held, for this kind of thing. Let the pupil start with the knowledge of his own day as gathered and garnered in books, and not bother to find out things for himself. Moreover, man and his institutions are more worth studying than all the world besides. It would be a misfortune, he thought, if the advice given in the paper were followed in the schools.

We take the report of this speech as we find it in the columns of our contemporary "Intelligence" of Chicago, and we judge by the remarks that followed that the meaning we attach to it is precisely that which it conveyed to those who were present. These views, expressed by a man holding a most im-

portant official position, and eminent as an educational leader, are so strikingly opposed to the general verdict of scientific educators as to challenge examination. The question is, how shall science be taught? Only experience can answer. If there is any fact that experience has overwhelmingly illustrated and established, it is that mere book-teaching of science is void and of no effect—nay, that it is worse: that it has an actively injurious effect on the mind, which it deadens with meaningless jargon and befogs with ill-comprehended notions. The highest scientific authorities have proclaimed this; and a committee of the American Association for the Advancement of Science put on record three or four years ago their deliberate opinion that the book science taught in the schools of this country was valueless for any purpose of intellectual discipline. Superintendent Howland must have observed in the course of his wide experience how hollow and often how fantastically absurd are the ideas children acquire of things of which they are told, but which they have never seen or handled. Every one who has been a close observer of his own contemporaries must be aware of many a man and woman who, for want of early and practical familiarity with this or that class of physical facts, labors under a confirmed disability in dealing with all facts of that particular order. How is a knowledge of or interest in flowers and plants (for example) to be acquired, if not by personal handling and observation of the objects themselves? And are there not many persons who, for want of this practical training, go through life with little knowledge of flowers beyond the fact that they are of various colors and odors, and of plants that they are for the most part green and require soil and sunlight for their growth? Many a man will give abundant testimony showing how hard he has striven in mature years to gain a little knowledge from books of this or that branch of science, and what terribly uphill and, in the main, ineffectual work it has been, just on account of defect in his powers of observation, and in that memory for the forms and qualities of physical things which due exercise of the observing habit in early life develops. Take any man on the ground that has become familiar to him by actual observation, and he is at his best. Talk to the sportsman about guns and game, and you are amazed at the profusion and minuteness of his knowledge. Talk to the naturalist, and he is inexhaustible in his descriptions and explanations of the objects of his craft. Talk to the geologist, and you will find that the strata and their fossil contents are the true realities amid which he lives. But talk to any man about that which he has only learned from books, and, though his speech may be copious, it will lack a certain living quality that comes only from conversance with realities. Even in such a domain as history, which some may say can not be learned except from books, there is a marked difference between the man whose memory is simply laden with names and dates, and the man who has become, in a sense, practically acquainted with the memorials of past ages—who has studied their monuments, their arts, their coins, their charters, their institutions, and who has vivified the whole by a knowledge of similar things belonging to the present time. It is safe to say that no man will ever understand history from the mere perusal of a narrative; he must, in a manner, make himself a contemporary of the times he is reading about; and then he may know the past a little as an intelligent man of affairs knows the present.

We had a splendid example here in this city not many weeks ago of what book-teaching of science amounts to. The "Evening Post" gave a selection of over fifty answers given by young women of the average age of seventeen, all pupils of our public schools, most of them having gone through the highest

grade, to five very simple questions forming an examination paper set for candidates for admission to a free stenographic class at the Cooper Institute. These damsels were asked, among other things, to state how many motions the earth has, and how much time each occupies; also what causes the change of seasons. These things had been fully explained to them, as was supposed, at school; and all, or nearly all, had in point of fact retained some shreds of the phraseology in which the explanations had been conveyed. Here are some examples of the answers to the question as to the motions of the earth:

"One motion. One year. The motion of sun round the earth."

"Two motions. Night, Day, twelve hours for each."

"Four motions, it revolves on its axis around once a year, and the four motions cause the seasons spring, summer, fall, and winter."

"The revolution of the earth on its axis, and the inclination of 23½ per cent of its poles to the plane of its orbit."

"Two motions, day and night. The sun causes the earth to move around its axis every twenty-four hours."

"Two, Regular and Circular, twelve hours for each."

"If the earth would not be round, the sun and moon could not go round the earth. Sun takes twenty-four hours. Moon takes twenty-four hours. Stars at night."

We can not afford more space to this rubbish. Suffice it to say that our contemporary prints the answers given to the several questions by fifty-six of the candidates, and that they *all* display the most deplorable ignorance and confusion.

The problems of how science shall be taught in the public schools, or indeed whether it shall be brought into them at all, depend for their solution upon having the right kind of teachers. They need to realize the utter ignorance of the child-mind as it comes for instruction to the public school, and to understand how to build up in that mind a fabric of real and coherent knowledge. Let us turn children out of the public schools ignorant, if need be, of many things that are taught to them now; but let this idea at least be rooted in their minds, that this world is made up of real things; and this further idea, that words are worse than useless unless they can be applied in the most definite manner to well-understood objects of sense or of thought. What a blessing it would be if we could inspire the rising generation with a real horror of vague and meaningless language! It would mean nothing less than an intellectual revolution in the world—or at least in our considerable portion of it.

THE RECOGNITION OF TRUTH.

If there should arise a class of men who were able to distinguish, promptly and invariably, genuine things from imitations, facts from falsehoods, and truth from error, they would have an almost inconceivable advantage in the struggle of life. The tricks of impostors would never deceive them; the bubbles of visionaries would never delude them; they would never be misled by the sophistries of shallow theorists; never be enslaved by baseless superstitions. Such wisdom is so unlike what the world has ever known that the idea savors of Utopia or the millennium, and to express it seems almost childish. Yet it is a fact that some progress toward this ideal has been made—some increase of the power of recognizing truth has been gained. A class of men has arisen whose pursuit of health is not hampered by the delusion that disease is a punishment for lapses from religion, who do not waste their money on schemes for getting more power out of a machine than is put into it, who do not accept every statement that is put to them with rhetorical vehemence and defective evidence. This superior discernment—far from perfect, but the best that man has ever had—

is the possession of those who have adopted the scientific habit of thought. A writer in the "Lancet" remarks that a supersensitiveness with regard to truth is the essential characteristic of a scientific frame of mind. Every suggestion that is offered in explanation of phenomena which are imperfectly understood is received with cautious reserve. This characteristic is liable to be mistaken for uncertainty or for prejudice; but in reality it is solely the outward sign of a just appreciation of the numerous sources of fallacy, which so often tend to render the most brilliant speculations worthless, when examined rigidly and coldly by the ideal standard of truth. When gauging the probability of the truth of any suggested explanation, it is held to be scientifically unsound to welcome it merely because some one of undoubted honesty of purpose has expressed his entire belief in it. There is always the possibility of mental bias to be reckoned with, as well as the possibility of unconscious delusion. No single sense is to be implicitly trusted. A preconceived idea may lead to the recognition of one property, while others of greater importance are overlooked. Pushed to its logical conclusion, this ideal standard of truth demands more proof than can ever be obtained, and for working purposes it is found convenient to employ what may be called provisional truths, which we accept on account of the facts that appear to support them being vastly more numerous than those that appear to oppose them, or because they have been set forth by careful, conscientious observers, after thorough consideration and elimination of all probable sources of error.

Imperfect education fosters delusion; indeed, delusions are most rife with the ambitious condition which often comes from "a little learning," when the whole is liable to be rashly assumed from the part; when a false appearance of truth may be mistaken for explanation; when the result of an erroneous observation, unchecked by scientific training, may be hastily considered to amount to demonstration. Education can have no more important aim than to equip pupils with the best known method for the recognition of truth. Every day of their lives they will have to decide as to the truth or falsity of some statement; and what is to prevent their going astray, if they have not been practiced in searching out all modifying circumstances of a problem, if they have not been accustomed to finding the balance of evidence, and taught the great lesson that judgment is not to be given rashly, but must be suspended when sufficient data to warrant a decision are not obtainable? The old studies of our schools do nothing toward training the young in examining evidence and forming judgments. The study of science, however, when rightly conducted, mainly consists of the process of investigation, the very instrument which pupils must be able to use handily in after life to save themselves from becoming the victims of impostors and swindlers. Aside from the material advantages involved, the habit of making truth the goal of his exertions inspires in the young learner a respect and fondness for truth for its own sake which can not fail to have an elevating influence on his character. Science should have, therefore, an important place in every school programme; it should be introduced in the lowest grades, in order to give the child's unfolding faculties the proper bent; and it should be continued throughout the school course in order to save the half-formed habit of intelligent inquiry from being lost by an interruption of its exercise. Our children could well afford to grow up in ignorance of the height of Mount Chuquibamba and the length of the Brahmapootra; they might dispense with a smattering of French, or do without the Latin declensions and conjugations, if the time thus saved enabled them to gain some facility in sift-

ing truth from falsehood. An encouraging improvement in our educational ideas has been shown of late, and it seems as if the time could not be far distant when all who have any voice in the training of the young will see clearly what knowledge and what acquirements are of most worth.

LITERARY NOTICES.

INDIVIDUALISM, A SYSTEM OF POLITICS. By WORDSWORTH DONISTHORPE, Barrister-at-Law, author of "Principles of Plutology," etc. London and New York: Macmillan & Co. Pp. 393. Price, $4.

THIS is a work which we feel justified, after a careful perusal, in commending to the study of our readers. The questions which it discusses are of the first importance, and Mr. Donisthorpe gives one the impression of a man thoroughly familiar with his own ground, and whose conclusions have not been formed at hap-hazard or without deep and earnest reflection. The main idea of the book is that individualism properly understood furnishes the key to a true political system. The last thing Mr. Donisthorpe would wish to do would be to relax the bonds of society. His aim, on the contrary, is to strengthen and perfect society, in the first place, by a scientific separation of the domain of the state and that of private activity; and, secondly, by carrying to its fullest legitimate development the principle of individual liberty. He has not, perhaps, developed his thesis in the most coherent manner possible; we think the work might be rearranged and perhaps somewhat compressed, with advantage to the main argument; but meantime we are glad to recognize in it a powerful and timely plea for principles of government with which "The Popular Science Monthly" has always been distinctly in sympathy. Mr. Donisthorpe writes as a lawyer; and the influence of his juristic studies is visible on every page. At times his argument gains in force through the dispassionate practicality of the legal mind; and at times it assumes a character somewhat too forensic for the best general effect.

In Chapter I we have a discussion of the growth and evolution of the state. There is nothing here distinctly novel. As regards the origin of political government the author accepts the ideas of Mr. Spencer, and refers also with approval to "the learned and fascinating works of the late Sir Henry Maine." He develops well, however, the idea that the tendency of modern times has been toward the forming of larger and larger political aggregates; and that in the present day the facilities for communication and transport which science has made available have increased more wonderfully than ever the possibilities of state growth. Apparently Mr. Donisthorpe's ideal is one center of law—so far as law is an absolute necessity—and the widest possible individual liberty throughout the whole community. He is not a friend to what is called "local option"; he considers that it means little else than local tyranny, and perhaps he is right. He does not believe in cutting up a country into larger and smaller geographical squares, and making the conditions of life for each man depend on the particular square in which he chances to live. He holds that the same (legal) conditions of life should be available for all members of the community, and that these should be of the simplest character possible. "Imperial law," he says, "must henceforth be based on individual and local liberty."

Chapter II deals with "The Structure of the State." The author announces himself a thorough-going democrat, and ventures to lay down the principles to which a true democratic government must conform. We must refer to the book itself, however, for his definition and defense of democracy, including the principle, unreservedly accepted, of universal suffrage. One remark here is worth quoting: "Majorities for their own sakes would do well not to bring minorities to bay. The result may be either painful or humiliating—painful, as when the minority (in heads, in riches, and in organization) withstood the tyranny of the Stuarts; humiliating, as when England bowed down before the determined Boers of the Transvaal. It is not wise to threaten what you do not mean to perform. Minorities mean action; majorities as a rule do not."

In Chapter III, on "The Functions of the State," we have, in the first place, a *résumé* of the functions commonly assigned

to modern governments; and, secondly, a criticism of the tendency, just at present in the ascendant, of looking to legislation for the cure of all ills and the securing of all benefits. "The spirit of the individualist movement," the author tells us, "is one of resistance to any overstepping by the legislature of its normal boundaries. It is the embodiment of the absolute principle of civil liberty, or the greatest possible liberty of each compatible with the equal liberty of all." We need hardly observe that this is sound Spencerian doctrine. Later on in the volume the author has a good deal to say in criticism of Mr. Spencer's "Man *vs.* the State"; but this does not prevent his recognizing Mr. Spencer, on the first page of his preface, as the man "who has contributed more to the scientific study of society than any other thinker—not even excepting Auguste Comte or John Austin"; and as the one to whom the merit belongs "of formulating this (the individualistic) theory of government, and thus of laying the rough foundation on which a sound art of politics may be based." Mr. Donisthorpe laments the fact that in England to-day "the Conservative party have thrown in their lot with state socialism," and are now playing with the Liberals a game of grab for the votes of those whom a Socialistic programme attracts. He shows reasons, however, for holding that the present tendency is rather an eddy in the general current, than a main movement likely to be continued in the future—a reaction toward unintelligent political methods due to the recent inclusion (he is speaking of England) of lower layers of the population in the electorate.

We pass over Chapters IV and V, entitled "What is Property?" and "What is Capital?" which do not seem to us to have a very direct bearing on the main purpose of the book; while the style in which they are written is somewhat tiresomely disputatious. The chapters on "The Labor Question" and "The Capitalization of Labor," which immediately follow, are, on the other hand, full of interest. In the first of these the author describes with great force the present economic condition of the laboring classes. He accepts without reserve the Ricardian doctrine of the tendency of wages to a minimum, maintaining that it has been so irresistibly proved *a priori* that to discuss it in the light of any partial facts or observations is the merest waste of time. He pours unmeasured ridicule on the new-fangled doctrine of "the standard of comfort" by which some political economists try to make the Ricardian law appear less cruel in its operation. "Wagedom," says Mr. Donisthorpe, is only a shade better than serfdom, and is virtually a kind of serfdom. The remedy for it, however, does not lie in socialism, which would only aggravate all the ills of society, but in the substitution for the wage system of what Mr. Donisthorpe calls "the capitalization of labor." His idea is briefly this: The wage-earner at present takes, when he can get it, a certain average wage from his employer, the amount of which does not depend upon the profitableness or otherwise to his employer of the business carried on. In other words, the employer insures the laborer a certain wage independently of the fortunes of his business. Now, nobody insures another without charging something for it; and the capitalist class recoup themselves for insuring a certain average wage to their employés *by putting that average wage somewhat, perhaps considerably, below what their average profits would justify*. By the capitalization of labor Mr. Donisthorpe means treating labor as capital (which he contends it is), and establishing a partnership between it and capital—a true partnership, in which gains and losses would be shared. Mr. Donisthorpe shows how a beginning might be made by taking the average wages in one or more lines of business for a certain number of years, and fixing the proportion which these had borne to average profits during the same period. The laborers might then approach the capitalists and say: These are the wages you have been able to pay us on the principle of insuring us a fixed compensation whether your business prospered or not. Now, we wish to throw our labor as so much capital into your business, on the understanding that, if your profits are greater than the average profits of the period we have been considering, you will pay us in proportion, and that, if they are less, you will pay us in proportion also.

We must refer those of our readers who wish to see how much can be urged on behalf

of the plan proposed, to Mr. Donisthorpe's book, merely observing that, in point of practical suggestiveness, we consider the two chapters last mentioned worth a score of such books as "Looking Backward." We do not say that every difficulty has been fully met; but we do say that Mr. Donisthorpe has propounded a scheme which is not necessarily Utopian, and which seems to contain great promise of good. Surely, on the face of it, it is evident that society must some day discover some better principle than that according to which the laborer of to-day professedly gives the least amount of work for the largest amount obtainable in wages, and the capitalist the smallest amount in wages for the largest amount obtainable of work. Such a principle means war, means waste, means wide-spread social demoralization; and it must, if society is to endure, be succeeded at no distant day by some true principle of accommodation and harmony, in virtue of which it shall become the interest of the laboring classes to promote the creation of wealth by faithful and intelligent work, and the interest of the capitalist class to extend the fullest measure of justice to those whose labor fructifies their capital.

The closing chapter of the book contains a most effective criticism of socialism in reply to a Mr. J. L. Joynes, who, if we remember rightly, was a co-laborer with Mr. Henry George in England. It is satisfactory, in these days of crude theories and doleful vaticinations, to meet with a book written in as sober and withal as cheerful and hopeful a spirit as this of Mr. Donisthorpe's. We wish very much that the more helpful portions of it could be presented to the public in briefer and more popular form; but, as it is, we trust that the book, as a whole, will be read and pondered by all who are interested in social problems.

INTRODUCTION TO THE STUDY OF PHILOSOPHY. By WILLIAM T. HARRIS. Comprising Passages from his Writings, selected and arranged, with Commentary and Illustration, by MARIETTA KIES. New York: D. Appleton & Co. Pp. 287. Price, $1.50.

THIS compilation has been made in order to adapt for class use the teachings contained in the miscellaneous philosophical works and articles of Dr. Harris. Many of the passages have been taken from the "Journal of Speculative Philosophy," others from the editor's prefaces to volumes in the "International Education Series," from Dr. Harris's lectures at the Concord School of Philosophy, and from his articles in various educational journals. The illustrations supplied by Miss Kies are such as she has used with her classes of girls at Mount Holyoke Seminary. The opening chapters deal with "Methods of Study," the "Presuppositions of Experience," and the "Philosophy of Nature." The rest of the volume deals with man as a self-active individual, taking up in successive sections sense-perception, representation, reflection, the syllogism, the absolute idea or the reason, the emotions, and the will. The concluding chapter discusses the immortality of man. "Philosophy as presented by Dr. Harris," says Miss Kies in her preface, "gives to the student an interpretation and explanation of the phases of existence which render even the ordinary affairs of life in accordance with reason; and, for the higher or spiritual phases of life, his interpretations have the power of a great illumination."

PROBLEMS OF THE FUTURE, AND ESSAYS. By S. LAING. London: Chapman & Hall. Pp. 409. Price, 3*s.* 6*d.*

IT is characteristic of man to take pleasure in measuring his strength against obstacles. In the youth of the individual or the race, he delights in athletic contests; in the prime of life, he enjoys the struggle to obtain subsistence and comforts for his family, and the rewards of social eminence; and at a more advanced period the study and more or less perfect solution of intellectual problems afford him satisfaction. The world, or at any rate the Anglo-Saxon race, may be said to have reached its maturity, and intellectual problems are exciting our interest and engaging our powers as never before. There have been a few philosophers in every age since the beginning of history, but scientific, social, and religious questions are now occupying the minds of many who do not claim to be philosophers. "There is a large and, I believe, rapidly increasing class," says Mr. Laing in his introduction, "who have already acquired some elementary ideas about

science, and who desire to know more. Curiosity and culture are in effect convertible terms: the wish to know is the first condition of knowing. To many who are in this stage of culture, but who have neither the time nor faculty for following up closely the ever-widening circle of advanced thought, it may be interesting to get some general and popular idea of some of the unsolved problems which have been raised by modern science, and are occupying the thoughts of the men who lead its van." To meet the want defined in this passage is the object of the present volume. The questions which the author discusses in his earlier chapters relate to the past history of the earth and other cosmic bodies. These are, How long has the sun been giving out heat enough to sustain life on the earth? What is the universe made of? What has been the climate of the earth in geologic times? When was the Glacial period, and how long did it last? From these topics he passes to the consideration of the antiquity of man and the method of his origin. A chapter is devoted to "Animal Magnetism and Spiritualism"; several religious questions are then taken up; and, finally, certain economic problems are considered. The religious questions are, whether agnosticism is reconcilable with Christianity; how great a historical element there is in the Gospels; and whether the skepticism of the present day justifies pessimism. "The Creeds of Great Poets" are also passed in review. First of the political and economic essays is an analysis of the reasons for the tension which keeps Europe constantly armed; the others deal with the financial problems of England, and the increase of population with reference to the food-supply of the world. In the case of each problem which he raises, Mr. Laing makes evident what solution he deems most probable. His discussions show a thorough knowledge of and sympathy with the scientific enlightenment of the times; and, in regard to those questions which man *must* answer in the future, he is generally confident that science will be able to give a beneficent solution. The only exception is in regard to the food problem, where he can see relief only from a diminished birth-rate or an increased death-rate, and the idea of discovering new ways of producing edible products is not mentioned.

TIMBER AND SOME OF ITS DISEASES. By H. MARSHALL WARD. London and New York: Macmillan & Co. Pp. 295. Price, $1.75.

THIS work originated in a series of short articles in "Nature," and forms one of the Messrs. Macmillan's "Nature Series." It is intended as a popular scientific rather than an exhaustive and technical account of its subject. The opening chapters deal with the general character and structure and the properties and varieties of timbers; also with the classification of timbers based on these properties. An extended review of the theories about the ascent of water in tall trees is given, the conclusion of the author being that of the imbibition theory of Sachs and the osmosis-gas-pressure theory of Hartig and Godlewski and others, the latter is the more probable. While he admits that the rhythmical character of the respiration of protoplasm, on which the osmosis-pressure theory depends, is not proved, he maintains that recent researches are in favor of Godlewski's views as to the behavior of the protoplasm. The next three chapters deal with the dry-rot and other diseases of timber caused by various fungi, figures of which are given. The structure of the bark of trees, and the process of healing wounds by occlusion, are then described, with illustrations. Returning to diseases, the author describes "canker," or the larch disease, leaf diseases, and pine blister. The final chapter deals with the "damping off" of seedling trees.

INSTITUTES OF ECONOMICS. By E. B. ANDREWS, D. D., LL. D., President of Brown University. Boston: Silver, Burdett & Co. Pp. 227. Price, $1.30.

THE most conspicuous feature of this book is the thoroughness with which its contents has been analyzed, classified, and annotated. It is introduced by a chapter defining the field of economics and stating the nature of the chief schools of economists. The body of the work is divided into six parts, devoted respectively to production, exchange, money and credit, distribution, consumption, and "practical topics involving economic theory," which last includes chapters on coin and paper currency in the United States, taxation, and poverty. It is an elementary text-book, intended for classes in colleges and, with perhaps the omission of

the most difficult sections, for high-school and academy classes. Its point of view is historical, though it maintains the existence of general economic laws, absolutely and universally valid. Its sundering of economics from ethics, jurisprudence, and sociology in general is less arbitrary than in most treatises. It makes wealth, not exchange, the central conception of the science, and recognizes immaterial wealth as well as material. On the difficult topic of value, the fresh analyses of Böhm-Bawerk and Menger are heeded and in part followed. The leading ideas are distinguished by heavy type, and each section is accompanied by a list of references bearing upon its subject-matter, and by copious notes. The volume lacks an index.

ECLECTIC PHYSICAL GEOGRAPHY. By RUSSELL HINMAN. Cincinnati: Van Antwerp, Bragg & Co. Pp. 382. 12mo.

SINCE physical geography includes parts of nearly all branches of science, and its study precedes that of the sciences in many schools, an introductory chapter has been prefixed to this book, in which the chief properties of matter and of heat, light, magnetism, and electricity are set forth. The topics forming the body of the book are arranged in a logical order, putting first the relations of the earth to the other members of the solar system. After this difficult subject has been disposed of, the atmosphere is considered, for the reasons that it forms the outer envelope of the earth, and that its action is the proximate cause of all details in the relief of the land and of the more conspicuous phenomena of the sea. Next come descriptions of, first, the sea, and then the land. The subject of climate follows these, and the concluding chapters deal with life, from yeast up to man. The details concerning the various topics are put in small type. The text is illustrated by one hundred and fifty cuts and many maps.

A LENÂPÉ-ENGLISH DICTIONARY. Edited by DANIEL G. BRINTON, M. D., and Rev. ALBERT SEQAQKIND ANTHONY. Philadelphia: The Historical Society of Pennsylvania. Pp. 236. Price, $3.

THIS vocabulary is based upon an anonymous manuscript in the archives of the Moravian church at Bethlehem, Pa., supposed to have been compiled by the Rev. C. F. Dencke, and containing about three thousand seven hundred words. The manuscript was carefully examined by the Rev. A. S. Anthony, who is a born Lenâpé, after which he and Mr. Brinton together passed in review every word in the dictionary. No attempt has been made to increase the lexicography by the insertion of words or forms obtained from the Delaware language of to-day. The editors have confined their efforts to presenting this work as exclusively concerned with the dialect as employed by the Moravian missionaries; and hence all additions to the vocabulary have been from their writings. A full index enables the equivalent of any English word to be found in the dictionary, if it is therein. The volume is printed on rough, heavy paper, with untrimmed edges. It is the first of "The Penn'a Students' Series," a series of volumes to contain material of interest to the students of Pennsylvanian history. Copies may be procured from the Librarian of the Historical Society, 1300 Locust Street, Philadelphia.

THE INDUSTRIAL PROGRESS OF THE NATION. By EDWARD ATKINSON, LL. D., Ph. D. New York: G. P. Putnam's Sons. Pp. 395. Price, $2.50.

UNDER the above title Mr. Atkinson has combined two series of magazine articles dealing with economic subjects, together with two or three addresses not before published. The statements and inferences presented in this volume are based on the author's extended study of the national accounts and the statistics of international commerce. In the paper which stands first, the idea is presented that "while the power of mankind to consume the products of the earth is limited, the source from which man may draw satisfaction for his material wants is practically unlimited." A special part of the subject of production and consumption, namely, the food question in America and Europe, is treated in the next essay, and a host of facts and figures are given bearing on the existence of waste and want side by side. In the two articles on "The Relative Strength and Weakness of Nations," the strength of democracy, as shown in America, and the weakness of nations which are governed by monarchs, are analyzed. Following these is a series of papers dealing with the distribution of the products of industry, and

as connected with this subject the author discusses in another essay the question "What shall be taxed?" The general conclusions to which this series of inquiries leads him are, that the working classes are obtaining a constantly increasing and the capitalists a constantly diminishing share of an increasing product; that the share which any person may secure depends upon his use of his own abilities; and that all laws restricting the free use of time and talent are inconsistent with progress. In the latter portion of the volume are papers on "Slow-burning Construction" (illustrated); "The Missing Science" (in which an economical method and apparatus for cooking are described); "A Single Tax on Land"; and "Religion and Life." The discussions in this volume are characterized by thoroughness of study, and an earnest desire to spread enlightenment on these important subjects.

A third hand-book of pronunciation has been published by *William H. P. Phyfe*, entitled *Seven Thousand Words often Mispronounced* (Putnam, $1.25). It is intended to include all the English words and names and the foreign words liable to be mispronounced by an English-speaking person. The words are all arranged in one alphabetical list, the names only beginning with capitals. Pronunciation is indicated by respelling in full, and in some cases how the word is *not* sounded is also indicated, and other explanatory notes are inserted. Where several important pronunciations of a word occur, the fact is indicated, Webster's pronunciation being generally placed first. Prefixed to the list are a chapter on the sounds of the English language, suggestions on the use of the book, and a key of diacritical marks. The author enumerates forty-two sounds in English, although the American Philological Association recognizes only forty—the two additional ones being obtained by distinguishing the vowel in *serge* from that in *urge*, and the one in *dog* from that in *odd*. Two instances of carelessness are, that the author names as one of his authorities "Worcester's Unabridged Dictionary," meaning "Worcester's Quarto Dictionary," and the only pronunciation of *Algonquin* given in the Supplement to Webster is ignored. The volume is printed in clear type on fine paper.

We have received of what might be styled calendar publications of the Smithsonian Institution, Mr. *G. H. Boehmer's* Report on *Exchanges* for the year ending June 30, 1887, and nine *Accounts of Progress* in as many branches of investigation in the year 1886. In the first of these publications, Mr. Boehmer, after relating the year's transactions in his office, reiterates the recommendation that has been made in previous reports, for the designation of a permanent agency abroad to give personal attention to the business of exchanges. His opinion that otherwise only temporary results can be obtained is confirmed by his own experiences.—In his *Account of the Progress of North American Geology* for 1886, Mr. *Nelson H. Darton* has sought to include abstracts, without bias or partiality, of all important publications distributed during the year. It is unfortunate, and hardly in keeping with the character of an institution like the Smithsonian — especially when three years are taken for the printing—that hurried preparation is offered as a reason for imperfections, and limitations of space for omitting the bibliography, which is to be made a bulletin of the Geological Survey. Mr. *C. G. Rockwood, Jr.*, arranges his *Account of Progress of Vulcanology and Seismology* under the heads, as heretofore, of Vulcanology—including volcanic phenomena of 1886, volcanic phenomena of previous years, and causes of volcanic action; Seismology — earthquakes of 1886, earthquake lists of 1885; catalogues of earthquakes of previous years, and study of earthquakes; and Seismometry—instrumental records and instruments. A bibliography of eight pages is appended. — Mr. *John Belknap Marcou* furnishes to the series a *Bibliography of North American Paleontology*, giving the titles of works in the order of the authors' names, alphabetically, and descriptions or analyses of the contents of the more elaborate ones, in some instances of considerable fullness. — The *Account of Geography and Exploration*, by *William Libbey, Jr.*, comprises extremely brief accounts, by continents, of the principal explorations of the year, their purposes and facts. In the *Account of Progress in Physics*, Prof. *George F. Barker* gives lucid analyses of the principal papers presented, with results determined

or suggested on the general subject and in mechanics, heat, light, and electricity. A necrology and bibliography supplement the text.—Prof. *H. Carrington Bolton*, in the *Account of Progress in Chemistry*, gives similarly clear notices of papers, discoveries, and experiments in chemistry, with necrology and bibliography.—The *Progress of Mineralogy* is described by *Edward S. Dana* under the heads of "General Works" on the subject, "Crystallography and Physical Mineralogy," "Chemical Mineralogy," "New Mineral Occurrences in the United States and Elsewhere," and "New Minerals." The bibliography includes brief references to papers upon mineral species.—As characteristic of *Progress in Zoölogy*, Mr. *Theodore Gill* observes that more and more attention is being paid to histology and embryology, perhaps at an undue expense to sytematic zoölogy, and regrets the tendency as hurtful to the welfare of the science, but hopes that in due time it will be corrected. The subject is reviewed in the order of zoölogical classification, and a necrology is supplied.—In the account of *Progress of Anthropology*, Prof. *Otis T. Mason* draws attention to comprehensive summaries, courses of lectures, and descriptions of instrumentalities. The heads are, "Archæology," "Biology," "Psychology," "Ethnology," "Comparative Philology," and "Mythology and Folk Lore." Clear ideas of the principal papers are given in the abstracts. A bibliography is added.

Mr. *Otis T. Mason* gives in the papers of the United States National Museum a valuable contribution to anthropology in the shape of an illustrated paper on the *Cradles of the American Aborigines*. The author finds that in both Americas the majority of aboriginal children are confined in a sort of cradle from their birth till they are able to walk about. During this period the cradle serves many purposes—as a mere nest for the helpless infant, as a bed so constructed and manipulated as to permit sleep in either a vertical or horizontal position, as a vehicle for carrying the child suspended on the mother's back or from the saddle-bow, as, indeed, a cradle to be hung on the limbs of trees to rock, as a playhouse and baby-jumper, and as a kind of training school whence the child emerges little by little till it leaves it altogether. These various uses are exhibited in the accounts which follow of the cradle systems of the different tribes. Methods of strapping the limbs and treating the head and their effects on the form, also enter into consideration.—Mr. *Walter Hough's* paper *On the Preservation of Museum Specimens from Insects and the Effects of Dampness* considers the virtues and defects of various poisonous preparations, and supplies directions for accomplishing the objects implied in the title.—*Ethno-Conchology: A Study of Primitive Money*, by *Robert E. C. Stearns*, describes the many kinds of shells that have been applied by primitive people in all parts of the world to the purposes of a currency, the methods of preparing and using them, more particularly the wampum belts of our Eastern Indians, and the shell money of the Pacific coast. The text is illustrated by nine plates and many inserted cuts, and some dozen other papers are cited in the bibliography.— Dr. *J. H. Porter's Notes on the Artificial Deformation of Children among Savages and Civilized Peoples* is also published in connection with Prof. Mason's *Cradles*, to which it bears a close relation, as it is in the cradles that the deformations are started. The subject is considered by Dr. Porter from a broad philosophical point of view, without much reference to special methods of deformation. These are mentioned in a summary of "General Notes on Deformition," which is at the same time a bibliography.—Prof. *Mason's The Human Beast of Burden* is of a piece in value and interest with his paper on "Cradles." The author is set by the sight of an express train to reflecting on the long and tiresome experiences through which the human mind has passed upward to that climax of invention. At the lower end of this line "we come at last to the primitive common carrier, the pack-man himself, and also the pack-woman, for men and women were the first beasts of burden." This person, with his load and his method of attaching and managing it, are considered under the aspects they present or have presented in different countries and ages; and the whole is made plain by means of pertinent illustrations.

Further contributions by Dr. *R. W. Shufeldt* to the study of the bone-structures of birds include *Observations upon the Osteology of the Order Tubinares and Stegano-*

podes, or albatrosses, fulmars, shearwaters, petrels, gannets, cormorants, pelicans, etc.; similar *Studies of the Sub-family Ardeinæ*, of which the great blue heron, *Ardea herodias*, is selected as the type; and, under the heading of *Contributions to the Comparative Osteology of Arctic and Sub-arctic Water-Birds*, a memoir on "The Auklets."

The number of *The American Journal of Psychology* (E. C. Sanford, Worcester, Mass., $5 a year) which completes its second year contains three principal articles. The first of these is by Charles L. Edwards, on the "Folk-lore of the Bahama Negroes," and embodies many stories similar in character to those which have been recently obtained from the negroes of our Southern States. The collection is introduced by several pages of description of the islands and the people. The second paper is "On some Characteristics of Symbolic Logic," by Christine L. Franklin. The fourth and concluding paper of Dr. W. H. Burnham's series on "Memory, historically and experimentally considered," appears in this number. In this paper Dr. Burnham sketches the progress of recent theories. He finds that the view that "the essence of memory is a functional disposition persisting in the brain is, perhaps, the one most widely held by contemporary psychologists." He also glances at the recent experimental studies upon memory, and appends to his paper a bibliography of the most important literature of the subject.

In *The Chemistry of Narcotics*, a pamphlet by Prof. *E. Haworth* (the author, Oskaloosa, Iowa, 25 cents), a brief account is given of the preparation and chemical character of the common alcoholic beverages, chloral, the bromides, and the vegetable alkaloids. A table of percentages of alcohol in foreign and domestic alcoholic beverages is appended.

The Cosmic Law of Thermal Repulsion (Wiley, 75 cents) is an attempt to account for the tails of comets. The author's view is, that the projected matter forming the tail has been separated from the body of the comet by the radiant energy of the sun. He states the details of his hypothesis in the present essay, and quotes from many scientific authorities passages which directly or indirectly support it.

The popular lectures and discussions given before the Brooklyn Ethical Association last winter have been published in book-form under the title *Evolution* (James H. West, Boston). The fifteen papers on various evolutionary topics which the volume comprises were noticed in these pages when published separately.

A paper on *Marine Shells and Fragments of Shells in the Till near Boston*, by Prof. *Warren Upham*, has been published in the Proceedings of the Boston Society of Natural History, Vol. XXIV. The fossils here described have been before regarded as evidence that the land in which they are found had been previously submerged beneath the sea. Instead of this, the observations of Prof. Upham go to show that the fossils were brought to their present positions from the bed of the sea on the north, by the ice-sheet. In the same volume is a paper on *The Structure of Drumlins*, also by Prof. *Upham*. Another recent paper by him, on *Glaciation of Mountains in New England and New York*, is published in "Appalachia," Vol. V, No. IV.

In a bulletin on *Natural Gas in Minnesota*, the geologist of that State, Prof. *N. H. Winchell*, reviews the geological facts and the results of experiments bearing on the question whether gas in any considerable quantity is likely to be found in Minnesota. His conclusions are, that the great formations that furnish gas in the United States are almost wholly wanting in Minnesota; that the gas which comes from shallow wells at Freeborn is confined to the drift; and that if gas is found in Minnesota in a lower formation than it has been found in anywhere else, as has been predicted, it will be something new in geology.

The publication of a treatise on the *Paleontology of the Cretaceous Formations of Texas* has been undertaken by Prof. *Robert T. Hill*, of the University of Texas, at Austin. It is to be published in installments, at twenty-five cents each. Part I, now issued, comprises descriptions of three specimens, with plates. The same author has also published Part I of a *Check-List of the Invertebrate Fossils from the Cretaceous Formations of Texas, accompanied by Notes on their Geographic and Geologic Distribution*. In "The

American Journal of Science" has appeared recently a paper by him on the *Relation of the Uppermost Cretaceous Beds of the Eastern and Southern United States*, and in "The American Geologist" another on *The Foraminiferal Origin of Certain Cretaceous Limestones and the Sequence of Sediments in North American Cretaceous.*

The little *Hand-Book of Precious Stones*, by *M. D. Rothschild* (Putnam, $1), gives a brief sketch of the properties of each mineral used in jewelry. The specific descriptions are introduced by directions for recognizing and determining the characters by which the quality of precious stones is ascertained. A table of hardness and specific gravity is appended.

Three memoirs on *Meteoric Iron*, by *George F. Kunz*, relate respectively to a mass weighing 15½ ounces, which was found on Linnville Mountain, N. C., about 1882; a mass of 25·61 pounds weight, which was found in Laramie County, Wyoming, in January, 1887; and the Johnson County (Arkansas) mass, which fell in 1886, and is noteworthy as having been the largest mass ever actually seen to fall. It weighed 107½ pounds. Physical descriptions, chemical analyses, and photographic illustrations of the stones are given. Another paper by Mr. Kunz includes "Mineralogical Notes" on "Phenacite from Maine," "Quartz Pseudomorphs after Spodumene," "A Remarkable Variety of Transparent Oligoclase," "Apatite from near Yonkers, N. Y., "Cyanite from North Carolina," and an "Aragonite Pseudomorph."

A valuable contribution to the study of the structure of the crinoids is given in a paper entitled *Discovery of the Ventral Structure of Taxocrinus and Haplocrinus, and Consequent Modifications in the Classification of the Crinoidea*, by *Charles Wachsmuth*, of Burlington, Iowa, and *Frank Springer*, of Las Vegas, N. M. The descriptions are supplemented by excellent plate illustrations.

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Bigelow, Prof. Frank H. The Solar Corona, discussed by Celestial Harmonics. Washington: Smithsonian Institution. Pp. 20, with Plate.

Billings, John S., M. D., and colaborers. The National Medical Dictionary. Philadelphia: Lea Brothers & Co. 2 vols. Pp. 781, 799. Leather. $14.

Bonham, J. M. Railway Secrecy and Trusts. New York: G. P. Putnam's Sons. Pp. 188.

Brace, C. Loring. The Unknown God; or, Inspiration among pre-Christian Races. New York: A. C. Armstrong & Son. Pp. 336. $2.50.

Brooklyn Ethical Association. Lectures and Discussions on Evolution. Boston: James H. West. Pp. 400. $2.

Byrnes, William, Editor. "Lock and Bell." Monthly. New York and Philadelphia. Pp. 24. 10 cents, $1 a year.

Cajori, Prof. Florian, New Orleans. History of Infinite Series. Pp. 22.

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Children's Aid Society, New York. Thirty-seventh Annual Report. Pp. 112.

Clarke, F. W. Meteorite Collection in the National Museum; Catalogue, Smithsonian Institution. Pp. 11.—Relative Abundance of the Chemical Elements. Philosophical Society of Washington. Pp. 12.

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Green, H. L., Buffalo, N. Y. The Bruno Monument. Plate.

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Hensoldt, Dr. H., Columbia College, New York. Natural History in Elementary Schools. Pp. 19.—A Naturalist's Rambles in Ceylon. Pp. 18.

Hornaday, W. T. The Extermination of the American Bison. Washington: Smithsonian Institution. Pp. 80, with Map.

Howland, George. Practical Hints for the Teachers of Public Schools. New York: D. Appleton & Co. Pp. 198.

Illinois, Statistics of Coal in, 1889. Springfield. Pp. 184.

Iowa Agricultural Experiment Station, Ames. Bulletin No. 7, containing Seven Papers. Pp. 42.

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James, Joseph F., Washington. On "Laurentian" as applied to a Quaternary Terrane. Pp. 7.

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Minnesota State Board of Health. Public Health in Minnesota. Pp. 8.

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Ostrom, Kurre W. Massage and the Original Swedish Movements. Philadelphia: P. Blakiston, Son & Co. Pp. 97. 75 cents.

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POPULAR MISCELLANY.

The Future of our Weather Service.—Everybody has been noticing that more and more of our official weather predictions turn out wrong, and in the hope of restoring their former efficiency several bills have been introduced into Congress within the last few years for transferring the Weather Service from the War Department to a civil bureau. The reasons for such a change, as stated in a pamphlet sent to us by Mr. H. H. Clayton, are that military regulations hamper the scientific work of the bureau, and cause civilians, who have joined the service from aptitude for science, to resign. The abler military men, also, seeing no hope of promotion in the Signal Corps, generally prefer the line. The natural result has been that, as General Greely reports, the service is full of incompetents, and the percentage of successful weather predictions has decreased in the last five or six years from eighty-seven to seventy-six per cent. During the same time the weather service in European countries has been steadily gaining in efficiency. The objections to the transfer are: First, that military control is claimed to secure superior promptness, accuracy, and continuity of record, which is met by the statement that the European weather services are entirely civilian, and our own depends for some of its data upon observations telegraphed by civilian observers from about twenty stations in Canada. Second, it is claimed that only military discipline could keep men in disagreeable or dangerous places; but civilian observers are found to man the Canadian meteorological outposts in Manitoba, and the mountain-peak stations in Europe. Third, it has been urged that the cost of the weather service would be increased by civilian control; but our military weather service costs more than the civilian services of all the governments of Europe put together. The appropriations are now about $900,000 a year, and some considerable reduction that has been made in the cost during the last few years has been due to the employment of civilian aid. Fourth, it has been urged that the military training of the observers would be of value in case of war; but if this argument is valid, the postal service and all the other Government departments should be put under military control. A fifth objection is, that in a civil bureau the appointments would be controlled by political influence. But with the protection of the civil service rules, it is probable that the bureau would be at least as free from favoritism as the army is. It has also been objected that the Government would be breaking its contract with the men of the Signal Corps if they were transferred to a civil bureau. But this difficulty could be met by allowing the military men now in the bureau to choose whether they would go with the Weather Service or stay with the Signal Corps. The chief signal officer is even better aware of the defects of the Weather Service than any outside critic. But the

remedy which General Greely proposes is to replace the second lieutenants in the Weather Service by officers of higher rank, and that future vacancies in the lowest rank of commissioned officers in the service shall be filled by transfer from the line of the army. This latter provision, by taking away hope of promotion from the sergeants and privates, would deter able men from entering the lower grades, and gaining the experience necessary for filling the higher positions. Moreover, the Weather Service has so absorbed the Signal Corps that the major-general in command of the army is now urging the formation of a special Signal Corps for actual army purposes. Both these schemes would involve additional expense, but the transfer of the Weather Service to, say, the Department of Agriculture, would secure the same ends by leaving the present Signal Corps free for signaling service, and allowing the meteorological work to be put in charge of scientific men instead of soldiers, while the cost of the work would be lessened instead of increased.

Open-air Travel for Consumption.—Dr. Henry L. Bowditch has given the Climatological Association an account of the treatment which seems to have counteracted a strong tendency to consumption in his own family. In 1808 his father, then thirty-five years old, was undoubtedly threatened with consumption. On August 29th of that year, when thus ill, he started from Salem, Mass., with a friend as his companion and driver, in an open one-horse chaise, for a tour through New England. The trip lasted thirty days and covered 748 miles. During that time he passed from the deepest mental discouragement and physical weakness through all stages of feeling up to a real enjoyment of life. His journey, though benefiting him immensely, probably did not wholly cure him, but it proved to him the absolute need he had of regular, daily, physical, open-air exercise. Afterward, under walks of one and a half to two miles, taken three times daily, all pulmonary troubles disappeared. He died, thirty years after the journey, from carcinoma of the stomach, his lungs being normal except that one presented evidences of an ancient cicatrix at its apex. He prescribed for his children the same regular out-of-door exercise which had been so beneficial to him. As soon as they were old enough they were required to take daily morning walks of about a mile and a half. If at any time they were observed to be drooping, they were taken from school and sent into the country to have farm-life and out-of-door play to their hearts' content. In consequence of this early instruction, all his descendants have become thoroughly impressed with the advantages of daily walking, of summer vacations in the country, and of camping out, etc., among the mountains. Dr. Bowditch's father had married his cousin, who, after long invalidism, died of chronic phthisis in 1834. Certainly a consanguineous union of two consumptives foreboded nothing but evil. Yet, of their eight children, six are either now alive or they arrived at adult age, married, and have had children and grandchildren, but not a trace of phthisis has appeared in any of these ninety-three persons. Dr. Bowditch sees nothing but the influence of out-of-door life to which this immunity of his family from consumption can be attributed. He has prescribed it, under proper precautions, in his practice for years, and says, in conclusion: "I have no objection to drugs, properly chosen, and I almost always administer them; but if the choice were given me to stay in the house and use medicines, or to live constantly in the open air without them, I should infinitely prefer the latter course in case of my being threatened with pulmonary consumption."

Precious Stones in the United States.—Mr. George F. Kunz's report on precious stones to the United States Geological Survey's Division of Mining Statistics shows that the industries of our country in that line, though not very extensive, are more considerably developed than they are generally known to be. The principal localities where gems are sought for systematically are at Mount Mica, Paris, Me., and Stony Point, N. C. Considerable quantities of tourmaline and other gems are produced at Mount Apatite, Auburn, Me. Several localities in North and South Carolina and Kentucky have been opened and are worked for the production of zircon and several other comparatively rare minerals which have been looked on heretofore only as gems, but are

now used for making the oxides of zirconium, lanthanum, cæsium, etc., to be employed for manufacturing purposes. A considerable number of cases of exceptional discoveries of gems of rare value are recorded, but they are so scattered as not to admit of grouping either by kind or place. Among the notable collections of gems in the United States mentioned by the author, are the three hundred and thirty-one antique gems of the late Rev. C. W. King, of England, which have been presented to the Metropolitan Museum of Art; Mr. Maxville Somerville's collection of fifteen hundred specimens of antique jewel-carving art, now on loan in the Metropolitan Museum; the Rev. Dr. W. Hayes Ward's three hundred ancient Babylonian, Persian, and other cylinders, now the property of the museum; the gem collection bequeathed by Dr. Isaac Lea to his daughter; and the series of precious stones, including about one thousand specimens, which, though not expensive, are the finest in the United States from an educational point of view, belonging to the National Museum. Mr. Kunz also gives some interesting fashion-notes about precious stones. They fluctuate in favor. Amethysts and cameos, much sought for ten years ago, are now thrown out. Rubies, already very high, are all the time rising. Topaz is not in demand. Coral is going out, while the popularity of amber is increasing. The use of Brazilian pebbles has decupled since 1878. The rare stones known as "fancy stones," which were formerly kept only as specimens, are now looked upon as articles of trade, and as part of the normal jeweler's stock. Mr. Kunz, as agent of Tiffany & Co., had a fine collection of North American precious and ornamental stones at the Paris Exposition, of which we have published a laudatory notice by "La Nature." It included three hundred and eighty-two specimens.

Botany as a Disciplinary Study.—Botany is recommended as a disciplinary study by Mr. Gerald McCarthy. It is much in its favor that the objects with which it deals are convenient of access and full of interest. Among the other advantages that it offers are the adaptation of the study of plants to the cultivation of the æsthetic faculties; to training the mind to habits of close observation and discriminating judgment, orderly arrangement, and the "logic of systemization"; its presenting the phenomena of life in its least complicated manifestations; plants offering better opportunities for thorough study than is practicable with minerals and animals; the usefulness of the study as a recreation and mental tonic; and the inexhaustible field for research which it offers. If some object that the technical names are hard, "at the beginning it will serve just as well to use the common vernacular name, or even invent names for one's self. The name is the least important thing one can learn about a plant, and it is not wise for the beginner to exhaust his time and patience in trying to choose the most proper of several possible and equally unintelligible names. Rather he should seek to group the specimens around common types, thus learning for himself the philosophy of the natural system." But the scientific name must eventually be learned, and it will come easier after the student has observed well for himself. For young pupils, and older ones who are unfamiliar with Latin, Miss Youmans's "First Book in Botany" is recommended as the best manual to begin with. It will lead up to the more advanced works. But more useful than any book is the student's field outfit, of lenses and knives, needles and trowel, and air-tight specimen-box.

Causes of Unhealthiness in Large Cities.—The mere age of London, said Dr. G. V. Poor, in a lecture at the Sanitary Institute, was one of the reasons why it became unwholesome. Roman London was buried deeply among rubbish of all kinds, much of which was putrescible, and therefore a source of danger in the soil. Ancient London was well placed and magnificently supplied with water through the Thames and many smaller streams. All the smaller streams had become disgracefully foul, "and for very shame had been covered over." That mediæval London was very unhealthy, a perfect fever-den, there could be no doubt. The causes of the enormous mortality lay in the marshy, undrained soil, fouled with refuse of every kind; in the filthy state of the unpaved city, and a perfectly swinish condition of the houses of the lower

orders; in the ill-nourished and drunken condition of the masses; in the state of superstition and brutality which made any measure of public health impracticable; in the bad management in epidemics, and in the incompetence of the medical faculty. There had been a great and manifest improvement in London. This could be credited to the increase of knowledge among the doctors and among the people generally; to vaccination and the modern plan of treating infectious diseases by the prompt separation of the patients; to the cheapness of food, clothing, and fuel, and the facility of obtaining fresh fruit and vegetables; to improved water-supply; and, although the system of sewage disposal was an undoubted evil, it had removed a great deal of filth from dwellings, and the balance was probably so far in its favor. The outlook in the future was obscured by increased overcrowding; the discharge of sewage into the Thames; and the increasing danger of the pollution of the water-supply by the accumulation of population along the valley of that river.

Clark University.—Clark University, Worcester, Mass., founded by Mr. Jonas G. Clark as an institution for the highest culture, was opened in October, 1889, in the departments of mathematics, physics, chemistry, biology, and psychology, under the presidency of G. Stanley Hall. The president is, for the time being, Professor of Psychology, and, with the assistance of Prof. Sandford, will assist students in the departments under that head by instruction, or by conference and guidance to literature; and will direct the work of special students in the history, methods, and organization of education, elementary, intermediate, and superior, lecturing on them during a part of the year. The professors are H. H. Donaldson in neurology, Edmund C. Sanford in psychology, Warren P. Lombard in physiology, F. Mall in anatomy, Albert A. Nicholson in physics. The methods of instruction include field-work, excursions, "coaching and cram classes," examinations, conferences, laboratory work, and lectures. The students are classified as independent, candidates for the degree of Ph. D., special students not candidates for a degree, medical students, and preliminary candidates or undergraduates. Twenty fellowships and ten scholarships have been provided by Mr. and Mrs. Clark, affording free tuition to thirty persons.

Huron and Iroquois Burials.—In a paper on "Indian Burial in New York," read at the meeting of the American Association, Mr. W. M. Beauchamp said that several modes of burial prevailed in the Huron and Iroquois family at the same time; but at a later date the influence of contact with Europeans and of the custom of adoption was observed. Although the usual position in Indian burial was supposed to be a sitting posture, facing the west, the bodies in a large proportion of the New York graves, while sitting, faced the east. Many burials, both early and recent, were horizontal, and often without deposited articles. For secondary burial, bone-pits were common in the western part of the State, appearing like the Huron ossuaries of Canada, or rising into mounds. The eastern Iroquois, at least after the formation of their league, did not rebury their dead. They used raised tombs, sometimes a mound of earth, and often a wooden structure like a small house. Burial in circles was secondary; the bodies were laid with their feet toward the center. Graves lined with stones are not frequent, but stone heaps were raised over some graves. Bodies were rarely buried one above another, with an intervening layer of earth. When buried in mounds, or in the bone-pits, they might be placed promiscuously or arranged with care. The mode of sepulture was affected by superstition and in consideration of crime. The New York Indians have for a long time been burying their dead much in the manner of their white neighbors.

How the Woodcock feeds.—A writer in "Forest and Stream" gives the following account of the way he saw woodcock "boring" for worms one moonlight night: "The birds would rest their bills upon the mud and stand in this position for several seconds, as if listening. Then, with a sudden, swift movement, they would drive the bill its entire length in the soil, hold it so for a second, and then as swiftly withdraw it. Though I watched the birds carefully with the glass, I could not detect the presence of a worm in their bills when they were withdrawn. But a subsequent process gave me

the clew to their method of feeding. After having bored over a considerable piece of ground—a square foot or more—they proceeded to execute what looked comically like a war-dance upon the perforated territory. They also occasionally tapped the ground with the tips of their wings. My intense curiosity to know the possible utility of this process was at length gratified by seeing a worm crawl, half-length, from one of the borings, when it was immediately pounced upon and devoured by one of the woodcock. Presently another worm made its appearance, and so on until the two woodcock had devoured as many as a dozen of them. Then the 'vein' seemed exhausted, and the birds took their leave. I have subsequently studied the philosophy of this method of digging bait, and have come to the conclusion that certain birds are a great deal wiser than certain bipeds without feathers. If you will take a sharpened stick and drive it into the ground a number of times, in a spot which is prolific with worms, and then tap on the ground with the stick for a few minutes, you will find that the worms will come to the surface, and that they will come up through the holes which you have made. I account for it by the supposition that the tapping of the stick somehow affects the worms the same as the patter of rain, and it is a well-known fact that worms come to the surface of the ground when it rains. The antics of the woodcocks after they had made their borings, then, were simply mimetic, and intended to delude the worms into the belief that it was raining in the upper world. The worms, being deceived, came up and were devoured. All this may seem ridiculous, but, if it is not true, will some naturalist please state how a woodcock can grasp and devour a worm when its bill is confined in a solid, tight-fitting tunnel of soil, and also how it is enabled to know the exact spot where it may sink its bill and strike a worm? And further, of all those who have seen a woodcock feeding, how many ever saw it withdraw a worm from the ground with its bill?"

The Colorado River of Texas.—The Colorado River of Texas is described by Prof. Robert T. Hill as presenting most interesting features, which rival in some respects those of the Colorado of the West. It begins in the dry arroyas which border the eastern scarp of the "Staked Plain," where it has cut cañons nearly a thousand feet deep in the soft Quaternary, Cretaceous, and Triassic strata, recording in their precipitousness both the aridity and the gradual elevation of the region. Between the ninety-seventh and ninety-eighth meridians it cuts through an area of Palæozoic rocks which was the land barrier between the Atlantic Ocean and the inland sea during Mesozoic times. Within the short distance traversed by the Atlantic section of its course, it has worn through the Cretaceous sediments of the plains and now traverses nearly every terrane from the late Quaternary to the earliest Cambrian. "Perhaps nowhere else in the world can be seen a more comprehensive geologic section, a better illustration of sedimentary and igneous rocks and their relation to topographic form and economic conditions and other geologic features dependent upon structure, than in that portion of the Colorado which traverses the counties of Burnet and Travis. . . . Here the erosion of the river-basin has exposed nearly ten thousand feet of structure that would otherwise not be exposed, and every bend serves to reveal some interesting topographic or geologic fact. . . . When it is added," the author concludes, "that no man has ever explored the deep cañons, that the paleontology is almost untouched, that hardly any details of all these grand features have been recorded, one can but feel that the student of geology has here an inexhaustible field before him."

NOTES.

Prof. H. A. Rowland, of Johns Hopkins University, has been elected one of the foreign members of the Royal Society, in recognition of his determination in absolute measure of the magnetic susceptibilities of iron, nickel, and cobalt; his accurate measurements of fundamental physical constants; his experimental proof of the electro-magnetic effect of convection; his theory and construction of curved diffraction-gratings of very great dispersive power; and the effectual aid which he has given to the progress of physics in America and other countries. Prof. Cannazaro, of Rome, and Prof. Chauveau, of Paris, were elected foreign members on the same day.

An experiment has been made at the agricultural station of Champ de l'Air, Vau-

dois, in hatching trout ova in complete darkness, the water being at a temperature of 5·8° C., or 42·4° F. The hatching was delayed fifteen days by the darkness. The advantages are claimed, in prolonging the incubation, that the young fry put into the streams in April or May more readily find food than in February or March; that they are more vigorous; and that fewer monstrosities are produced.

EXPERIMENTS in feeding milch-cows, described in the November "Bulletin" of the Massachusetts State Agricultural Experiment Station, attest the great economical value of corn-fodder, stover, and ensilage for the production and quality of milk and cream.

THE study of the effect of fertilizers on the quality of fruit is recommended by Prof. P. T. Austen as a line of inquiry distinct from their effect on its quantity. This involves a wide range of investigation, embracing, in fact, all the properties of the plant and the manner in which they are affected by manures, particularly the part played by each chemical substance in the plant and the specific action of fertilizing materials on the formation of those substances; together with the relation of the different species of plants to their chemical composition, and the extent to which plants of the same family produce substances of the same type. The influence of treatment with drugs opens a parallel line of investigation.

THE Rev. J. Owen Dorsay is preparing a monograph on Indian names, to contain lists, with English meanings, in six different languages—the whole number of names being thirty-one hundred and forty-six. The connection between the myths and some of the personal names will be considered; and certain classes of names—such as color names, iron names, and the names of composite beings—will be treated in detail.

THE latest published volume of HERR Richard Andree's "Ethnographical Parallels and Comparisons" deals with such topics as red hair, albinos, games, masks, marks of property, superstitions connected with the chase, "tree and man," circumcision, drawing among primitive people, thunderbolts, money for the dead, emotional expressions and gestures, demoniacs and mental disorders, etc.

THE report of Manchester (England) Technical School for the year ending July 31, 1889, shows an increase of students from 2,871 to 3,328. The most important extension during the year was the opening of a spinning and weaving department. The day classes in this department have but a small attendance as yet, but a considerable number of students are attending the evening sessions.

THE suggestion has been made in London that, as the French have erected the highest tower, the English shall dig the deepest hole—say on the exhibition grounds of 1851 in Hyde Park. The pit could be furnished with an elevator shaft, and lit up by electricity; and in each stratum there could be an excavated museum with specimens of the minerals, fossils, etc., afforded by it.

ACCORDING to a study by Dr. George N. Kreider, of Springfield, Ill., micro-organisms enter the body first by the skin—through lesions, openings of the sweat-pores, or sebaceous ducts, or by the sides of the hairs; and, secondly, by the mucous membrane—through lesions of the membrane, openings of the ducts or follicles, or pockets, sulci, or folds. There are also localized infections, originating in a manner as yet unknown, and giving rise to certain violent diseases; and universal infections, giving rise to hereditary transmissible disease. The severity of the infection varies with the condition of the body as regards idiosyncrasy, or strength, or weakness; the amount of infecting material that gains entrance; the character of the infecting material; and the tissue which it penetrates, and its location.

THE underlying motions of the Nile Delta are described by Mr. W. J. Flinders Petrie as those of depression on the coast and upheaval at Ismailia. Above these movements great changes have been made by wind-action. In some sites at least eight feet of ground have been removed and deposited in the water. This has partly caused the great retreat of the Red Sea head, and tends to form the characteristic swamps of that district. Formerly the Delta was a desert tract, with valleys inundulated by the Nile. Before historic times the Nile Valley was deep in water, partly estuarine, partly fluvial, and great rainfall then took place. That this was in the human age is shown by the position of worked flints.

A MEMORIAL to Prejevalski is to be erected on the shore of Lake Issyk-kul. It represents a rock, upon which an eagle is descending, having a map of Asia in its talons and an olive-branch in its beak. The monument will have the inscription, "To the first explorer of nature in Central Asia."

A CORRESPONDENT of "Nature" urges that boys should be tested for color-blindness in school—before they go out into life—so that they need not lose the time required for working up to positions on railroads or elsewhere in which ability to distinguish colors is essential.

A CURIOUS story is told, by a correspondent of "Nature," of a dog which was struck by lightning and considered dead, but which afterward partly recovered. It continued deaf and blind, and had to depend on its smell for recognition of persons and things.

OBITUARY NOTES.

PROF. CHESTER S. LYMAN, of Yale University, died in New Haven, Conn., January 29th, aged seventy-six years. A sketch of his life and works, and a portrait, were published in "The Popular Science Monthly" for November, 1887.

M. COSSON, member of the French Academy of Sciences, and author of several memoirs on the flora of Algeria and Tunis, died in Paris on the last day of the year 1889. He was President of the Botanical Society of France and Archivist of the Société d'Acclimation.

DR. WILLIAM RAMSAY MCNAB, Professor of Botany in the Royal College of Science, Dublin, recently died, suddenly, of heart disease. He was born in Edinburgh in 1844, his father, as his grandfather had been, being Curator of the Botanic Garden there. He studied at Edinburgh, where he was also assistant to Prof. Balfour, and at Berlin, practiced medicine for three years, after which, in 1870, he entered upon a biological career. He introduced important reforms in the method of teaching botany, chiefly by adopting the method of Sachs; was author of numerous works or papers relating to botany and fossil plants; was a practical student of geology; and collected coleoptera. He was appointed in 1888 Swiney Lecturer to the British Museum of Natural Sciences, and was at the time of his death about to begin a third course on fossil botany.

PROF. LORENZO RESPIGHI, Director of the Osservatorio Campidoglio, Rome, one of the most eminent scientific men in Italy, died December 10th.

THE people of Manchester interested in the subject have decided to erect in that city a memorial of James Prescott Joule, which shall take the form of a white marble statue, and also to set up a replica in bronze in some public place in the city. An international monument to James Watt is proposed, to be erected at Greenock, his birthplace, and to take the form of a large and thoroughly equipped technical school.

SENHOR JOSÉ AUGUSTO DE SERRZA, curator of the zoölogical department of the museum at Lisbon, Portugal, who has recently died, was the author of some useful memoirs on African birds, and of museum catalogues of certain orders.

EDOUARD PHILLIPPS, an eminent French mechanician and engineer, died December 14th, in his seventieth year. He left important works on mechanics and metallurgy, and his "Lectures" on hydraulics and hydrostatics, published in 1875, was highly appreciated. He was made a member of the Academy of Sciences, in the Section of Mechanics, in 1868.

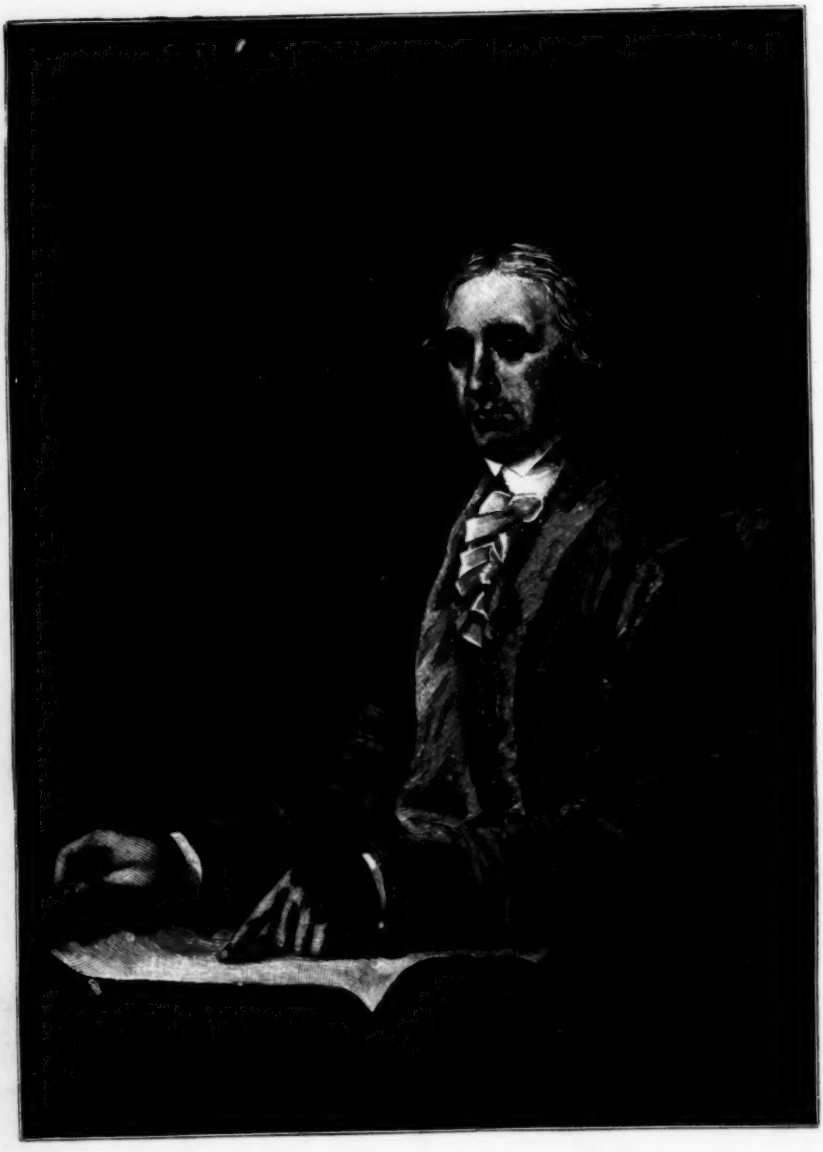
AMONG the recent foreign deaths is that of the Italian physicist Govi, whose name is closely associated with matters relating to the history of science, particularly in his own country. He prepared an interesting group for the International Electrical Exposition of 1881 of instruments which had been used by Galvani, Volta, and Nobili.

JULIEN SACAZE, a young epigraphist and archæologist of great repute in the provincial districts of France, has recently died. He discovered a considerable number of prehistoric monuments and sites in and near the Pyrenæan departments, co-operated in the foundation of the Pyrenæan Association and of a more local society at Comminges, and with Dr. F. Garrigo established the "Revue des Pyrénées et de la France Méridionale." The collections which he made in the course of his investigations are described as having been "superb." He left the manuscript of a work on the "Epigraphy of the Pyrenees," which will be published.

VICE-ADMIRAL CLOUÉ, who died in Paris on the 25th of December, was best known for the marine charts he constructed and for his exertions to make of practical value the property of oil in stilling the waves. When he entered the service the French marine was dependent on English or Dutch charts. He substituted for these French charts, many of which he prepared. He was born in 1817 and spent his life in the French naval service or positions connected with it, was appointed Governor of Martinique in 1872, and afterward held the position of Minister of the Marine and the Colonies. He was a member of the Bureau of Longitudes, of the Observatory and the Meteorological Council, and had been elected to a seat in the Institute.

MR. E. J. JONES, since 1883 an officer of the Geological Survey of India, who died October 15th, aged thirty years, was an associate of the Royal School of Mines and a chemist from the schools of Zurich and Würzburg. He contributed several geological and chemical papers to the publications of the Survey.

MR. JOHN TAVERNIER BARTRAM, who died recently at Stoke's Point, Bermuda, in his seventy-ninth year, was held in high esteem among scientific men as a naturalist. During the forty-two years that he resided at Stoke's Point, says "The Bermuda Colonist," he made a collection of birds, fishes, shells, and other natural curiosities, that has long since come to be "one of the things to be seen in Bermuda"; and for the past twenty-five years no scientific man who visited Bermuda and could get to Stoke's Point ever failed to pay him a visit. He contributed articles to the local press on the natural history and geology of Bermuda, and prepared hand-books on the cage-birds and the shells of the island.



DAVID RITTENHOUSE.